February, 1945 Vol. 34, No. 2

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INDUSTRIAL ARTS AND VOCATIONAL EDUCATION

TESTING NUMBER

The Shop Teachers' Professional Magazine

HEAVY DUTY UNIVERSAL
Heavy duty angular milling in all planes. (Bulletin No. 104).
CIRCULAR TABLE
Milling circles or cams, gear cutting, high speed continuous milling, etc. (Bulletin No. 118).
VERTICAL HEAD
Converts horizontal to vertical machine, retaining identical spindle characteristics. (Bulletin No. 108).
VISES
Standard and Heavy-Duty, plain and swivel types. Adaptable to special jaws to save fixtures. (Bulletin 117).
SLOTTER
Keyseating, broaching, general slotting, tool and die making, etc. (Bulletin No. 107).
HI-SPEED UNIVERSAL
High speed angular milling in all planes. (Bulletin No. 113).
DIVIDING HEAD
Precision indexing, spiral cutting mechanism and chuck also available. (Bulletin 119).

Cut Production Costs
WITH KEMPSMITH STANDARD
Milling Attachments!

ARBORS
and full line of standard accessories carried in stock. Adaptable to ANY make of milling machine equipped with standardized spindle. (Bulletin No. 116).

When expensive, "cost-upping" special machines or special attachments are not available, why not use standard equipment that can do the job just as well or even better? Kempsmith Standard Attachments mounted on a standard milling machine provide VERSATILITY for those special equipment jobs . . . at the same time retaining the high degree of rigidity and precision characteristic of Kempsmith machines for more than 56 years. It will pay you to investigate. Write for bulletins.

MAIL THIS COUPON TODAY

THE KEMPSMITH MACHINE CO.
1821 South 71st Street, Milwaukee 14, Wis., U.S.A.
Please mail me copy of bulletin No.....
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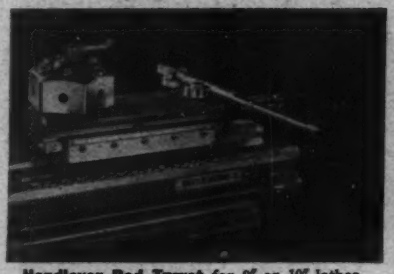
KEMPSMITH

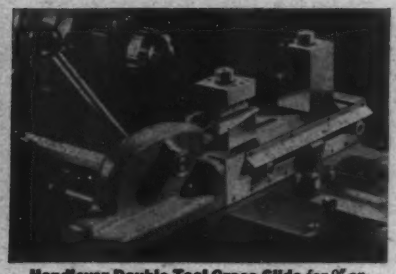
Precision Built Milling Machines Since 1888

MORE VERSATILITY

FROM SOUTH BEND LATHES WITH THESE ATTACHMENTS



Handlever Bed Turret for 9" or 10" lathes multiplies their versatility through multiple tooling for repetitive operations.



Handlever Double Tool Cross Slide for 9" or 10" lathes speeds up successive operations through the use of three cutting tools.

Screw Feed Double Tool Cross Slide for 16" lathes has both manual and power cross feed. Large graduated feed dial.

Handlever Draw-in Collet Attachment saves time on bar work. Collet can be operated and stock fed without stopping the spindle.

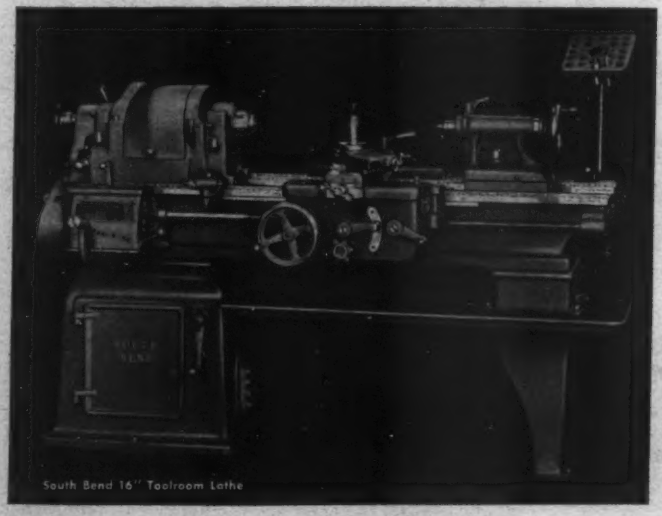
Handwheel Draw-in Collet Attachment is ideal for production and toolroom work that requires extremely close tolerances.

Collets from 1/16" to 1" in 1/64" steps. Complete sets of collets will save time.

Center Rest and **Follower Rest** for supporting long bar work while turning, threading, drilling, boring, etc.

4-Way Turret Tool Block permits use of four cutting tools which simplifies tooling for repetitive operations.

Taper Attachment for accurate taper turning and boring. Quickly engaged. Graduated in in both degrees and taper per foot.



South Bend 16" Toolroom Lathe

These and other practical attachments greatly increase the capacity of South Bend Lathes for handling a wide variety of operations. Their use will broaden your machine shop courses in both general and toolroom work.

Write for Catalog 77R in which all South Bend Attachments are illustrated and described. Also, state size and type of lathe required. These attachments are only available for use on South Bend Lathes.

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SOUTH BEND LATHE WORKS

Lathe Builders for 38 Years

466 E. MADISON STREET, SOUTH BEND 22, INDIANA

Wanted

Thousands of Trained Young Men and Women for the Printing Industry

The printing industry—one of America's leading industries—needs trained young men and women now. When peace comes other thousands will need vocational training and rehabilitation to equip them for real opportunities in this major American industry.

Tell your students about the Printing Industry . . . let them know that it is one of the three largest industries in America. Call their attention to the fact that it is the most stable of America's major industries. Stress the advantages it offers for continuing the educational process all through life. Point out that printing is basic in our modern industrial society.

The Graphic Arts Specification Folders featured in this advertisement are just one of many aids planned for the benefit of school executives, architects and others by our Education Engineering Department.

We will gladly mail you one of these folders giving floor plans, essential equipment and other data if you will write telling us the number of pupils you wish to accommodate, and whether Junior High, Senior High or Vocational School. There is no obligation.

Write us about ATF Offset and Letterpress equipment

Challenge
HAMILTON
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Education Department *American Type Founders*

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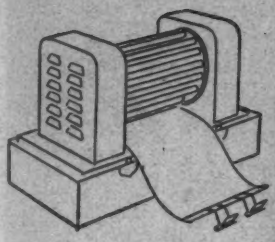

Mimeograph photochemical printer . . . .

It transfers ink line drawings to a stencil quickly, simply, at low cost

The brilliant "cold" light of the Mimeograph photochemical printer "prints" your drawing on a sensitized Mimeograph photochemical stencil sheet.

Sponging with water develops the drawing in complete detail. After the stencil is "set" with conditioning fluid and dried, it is ready to be placed on the Mimeograph duplicator.

The Mimeograph* photochemical means of stencilization has proved an invaluable teaching aid to the industrial arts. For here is a unique method that makes it possible to reproduce multiple copies of all project drawings, with a minimum amount of handling, and at very low cost.

No retracing is involved. All you need is the original ink drawing on translucent cloth or paper. This is placed in contact with a sensitized photochemical stencil sheet and together they are exposed to the cold, brilliant and uniform light of the printer. Then, after a brief and simple development operation, the stencil is ready to be placed on the Mimeograph duplicator, and dozens or hundreds of copies of the original drawing can be produced as needed.

Schools of all sizes are supplementing their Mimeograph duplicator with the Mimeograph photochemical equipment.

It is basic not only for the industrial arts but for many other departments. Get full details on operation and cost for your school by mailing coupon below. *No priority is needed.* A. B. Dick Company, Chicago.

Mimeograph

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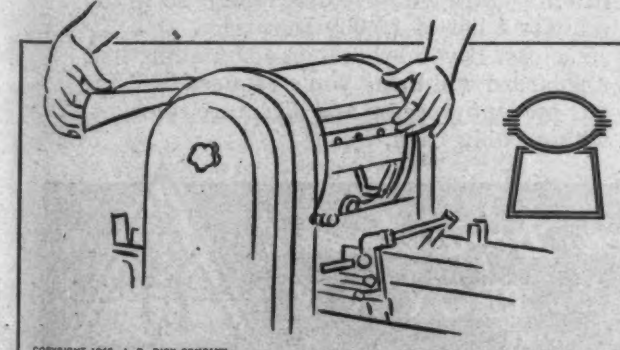

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A. B. Dick Company, Dept. IA-245, 720 W. Jackson Blvd., Chicago 6.
Send me full information on the Mimeograph photochemical printer.

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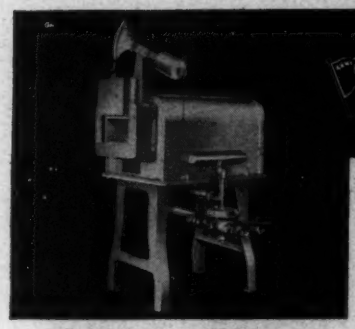
THE BEST INDUSTRIAL FURNACES MADE



Small Semi-Muffle Oven

Small Forge

HUNDREDS OF THESE STEWART FURNACES ARE IN THE VOCATIONAL DEPARTMENTS OF TECHNICAL SCHOOLS

Because Stewart units have been designed for efficient production heat treating in small shops and tool rooms, they are widely recognized as standard equipment for all types of industrial heat treating and vocational training work. For student instruction and reference with further details on Stewart Furnaces especially suitable for school shop use, write for our free "STEWART HANDBOOK of Heat Treating Information and Equipment." Also the new Stewart DATA FILE on school units.

STEWART INDUSTRIAL FURNACE DIV. of CHICAGO FLEXIBLE SHAFT CO.

Main Office: 5600 W. Roosevelt Rd., Dept. 129, Chicago 50, Ill.
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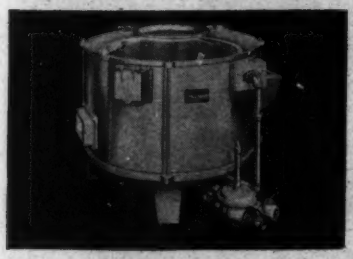
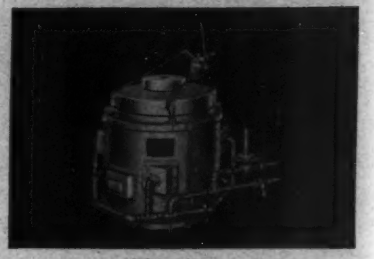


Round Pot Furnace



Melting Furnace

Bench Oven Furnace | Triple Purpose Combination "E" | Triple Purpose Combination "D" | Dual Combination

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In nine years we have distributed 19 gratis units to a list of 20,000 Industrial Arts Instructors. If you are not on our mailing list, a postcard will bring you a request card for our present program and all future releases, without obligation.

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Educational Service Department

BEHR-MANNING - - - TROY, N. Y.

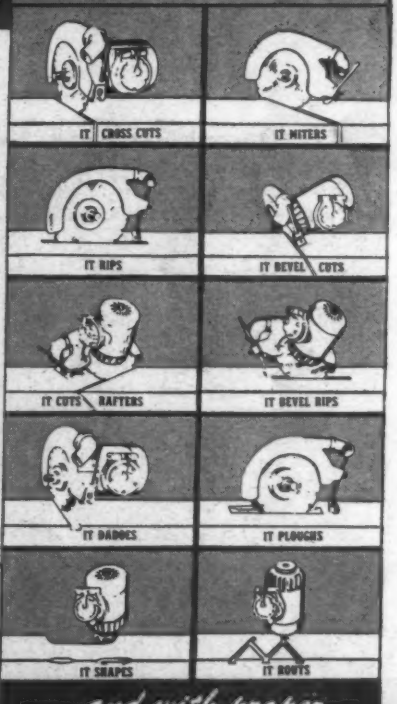
(DIVISION OF NORTON COMPANY)

QUALITY ABRASIVES

INDUSTRIAL ARTS AND VOCATIONAL EDUCATION, February, 1945, Volume 34, No. 2. Published monthly, except during July and August, by The Bruce Publishing Co., Milwaukee 1, Wis. Entered January 2, 1914, as Second-Class Matter at Milwaukee 1, Wis., under Act of March 3, 1879. Subscriptions — U. S., $2.50 per year. Canada and Foreign, $3.00. Single copies, 35 cents.

"Every vocational school should have a required course in the operation of this machine"

DE WALT is a complete shop in itself



This is a typical statement from Army and Navy officials charged with technical training — and from men in all branches of the services where woodworking is used.

DeWalt has proved itself on all the fighting fronts, cutting all kinds of lumber in all kinds of woodworking activities — including construction, pattern work, crating and boxing, maintenance and repair.

The perfection of the DeWalt Saw has created new methods in cutting wood, making obsolete old-style equipment previously used. As a result, many schools today find themselves inadequately equipped to prepare their students for the future.

We urge you to investigate DeWalt. This safe, easy-to-operate, flexible machine will occupy a prominent place in tomorrow's industry. Let your students get a "head-start" by *knowing* DeWalt now — as they prepare for *their* place in tomorrow's industry.

16 MM Sound Movie — Available for supervisor meetings at no obligation, a specially prepared DeWalt Sound Movie — "DeWalt SAWS in the War Program." Write for details.

DeWALT PRODUCTS CORPORATION
122 Fountain Avenue, Lancaster, Penna.

☐ Please send me literature on DeWalt Saws.
☐ I would like more information about DeWalt Sound Movie.

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...and with proper tools makes any cut possible!

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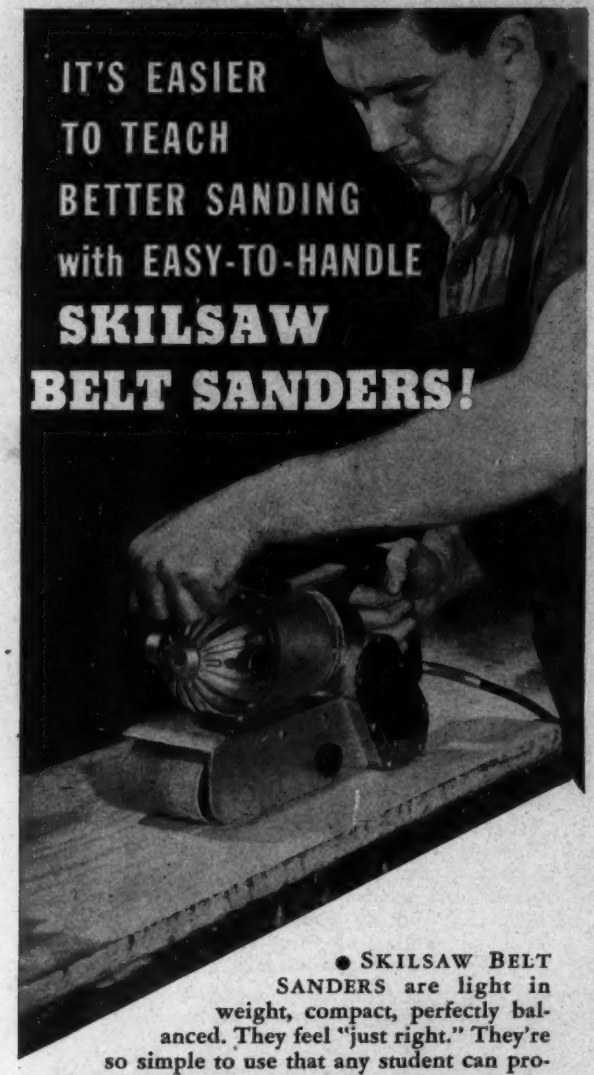

● SKILSAW BELT SANDERS are light in weight, compact, perfectly balanced. They feel "just right." They're so simple to use that any student can produce a finer finish faster and easier on any flat surface of wood, metal or compositions.

And SKILSAW BELT SANDERS are rugged, dependable, quality-built throughout so they last longer and operate at lower cost . . . help you keep your budget in line.

Let your distributor show you on your own work why SKILSAW BELT SANDERS belong in your manual training shop. Phone today for a demonstration.

SKILSAW BELT SANDERS are ideal for refinishing desks, blackboards and woodwork. They're preferred by industry everywhere for speed, economy and easy handling.

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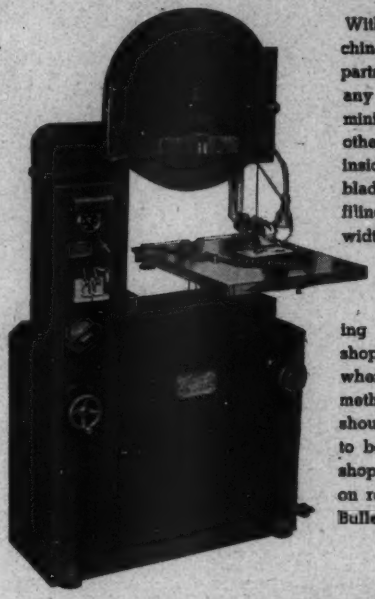
Sales and Service Branches in All Principal Cities

SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

Tannewitz DI-SAWS

Most Essential Requirement for Your Machine Shop!



With this extremely versatile machine, tools and dies, machine parts or other items of practically any shape may be made in the minimum of time from steel or any other material; for it provides for inside and outside sawing, using blades 3/32" to ½" wide, chain filing — in three different file widths, and endless belt polishing. Because of this great versatility as well as the fact that these machines are being widely used in machine shops throughout the country where they are obsoleting other methods, a TANNEWITZ DI-SAW should be the number one item to be purchased for your school shop. Complete details furnished on request. Just ask for DI-SAW Bulletin.

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.

ARMSTRONG
TURRET LATHE AND SCREW MACHINE TOOLS

Today, America Needs TURRET LATHE and SCREW MACHINE OPERATORS

The transition from tooling-up to all-out production has increased the need for turret lathe and screw machine operators. When preparing your courses to help fill this need it would be well to build them around ARMSTRONG TURRET LATHE and SCREW MACHINE TOOLS. These are provided for the basic operations, and take standard drills and knurls or cutters that anyone can quickly grind from stock shapes of high speed steel. Permanent, multiple-purpose tools, they reduce tooling-up to the selection of cutters, adjustment for clearance and tightening of set screws.

Write for catalog C-39a

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"The Tool Holder People" 322 N. Francisco Ave., Chicago, U. S. A.
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MAKE INDUSTRIAL PERFORMANCE *Your Yardstick*

When Selecting Equipment FOR VOCATIONAL TRAINING

Walker-Turner Drill Press performing special tapping operation at Industrial Timer Corp.

The real measure of Walker-Turner Machine Tools' value in vocational training lies in the diversified standard machining operations they are performing throughout Industry — and the great number of special operations to which they have been adapted. To school shops, these machines give an over-all industrial realism that cannot be obtained with less versatile equipment.

Important, too, are those Walker-Turner features which are particularly essential in industrial training—things like simplified design, easy operation, rugged construction and the latest in safety engineering. Moreover, Walker-Turner Machine Tools are priced to fit your budget, promptly available for war production training. Follow the lead of the industries for which your students are being trained. Send for complete story on Walker-Turner Machine Tools.

WALKER-TURNER COMPANY, Inc., Plainfield, N. J.

Walker-Turner Band Saw cutting Plexiglas bomber blister at Rohm and Haas Co.

Walker-Turner Radial Saw cutting a coil form at General Ceramics and Steatite Corp.

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MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

TEACH YOUR STUDENTS
Mistake-Proof Soldering

Photo Courtesy Pan American World Airways

KESTER *Cored Solders*

Solder application is virtually mistake-proof where Kester Cored Solders are used. Flux and solder are applied in one, quick, simple operation, because positive-acting flux is right in the solder. No messy flux pots to spatter walls and benches.

Your students will use Kester Solders on the job. Experience *now* will help them *then*. They will appreciate knowledge of the complete Kester line, which provides a strand and core size, and alloy and flux combination, for any type of solder job.

And they will appreciate experience with the two kinds of Kester Cored Solders — rosin core and acid core.

Kester Rosin-Core Solder is for electrical work. It contains a patented, plastic rosin flux that does not cause corrosion or injure insulation. Dangers of short circuits are eliminated. Terminals are permanently protected.

Kester Acid-Core Solder is for general work. The core does not leak. The flux will not gather moisture.

Forty-six years of solder experience give you Kester flux-filled solders that form clean, tight solder-bonds — bonds that hold against shocks, vibration, bending, twisting, contraction and expansion. Teach top solder-practice with Kester. Order from your wholesaler.

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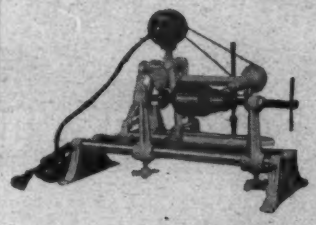
KESTER
FLUX-FILLED SOLDER

WEIDENHOFF B&E SERVICE TOOLS

For Battery and Electrical Work

Below are shown a few of the many efficient and reliable pieces of Weidenhoff equipment used by the trade and are ideal for the school shop. Write for full particulars on the complete line for your school and the list of helpful Weidenhoff publications.

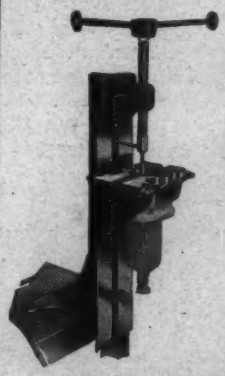


UNDERCUTTER

A heavy duty, precision mica undercutter. Undercuts commutators up to 6" diameter. Centers adjustable up to 18". Vee-blocks for centerless armatures. Motor universal-bronze sleeve bearings. Stroke regulated by adjustable stop. Sturdy steel horizontal support with machined keyway assures alignment and parallel movement.

GROWLER

Balanced ratio of wires and steel maintained to prevent over-heating and reduce current consumption. Meter indicates a defective armature winding, nature of defect and its exact location in armature, type of winding and pitch of coil. Field coils also tested by meter. Two switch positions — one for testing generator armatures, another for testing starting motor aand generator armatures.



PULLER PRESS

A quick-acting arbor and puller press. Used for removing and replacing bearings, bushings, races, slip rings and caps. Bendix drives and gear. Saves time and labor and prevents breakage. Puller Plate has suitable openings for every job, including the small magneto bearing races. Maximum distance from drift pin to plate, 16½".

POLE PIECE SCREWDRIVER

For instantly removing or replacing the most stubborn generator or starting motor pole piece screw without damaging parts. Pole pieces are easily pulled into position by the tremendous torque applied at the screw head.

AUTOMOTIVE SERVICE WEIDENHOFF EQUIPMENT AVIATION

JOSEPH WEIDENHOFF, INC.
CHICAGO 24 ILLINOIS

When is FIRE *too* COLD?

FIRE was both a tool and a limitation for the ancients. With it they made things of tin and lead, silver and gold. But their fires were never hot enough for the sterner metals.

Man's progress through the ages has been accelerated each time he has learned to create and control a higher temperature.

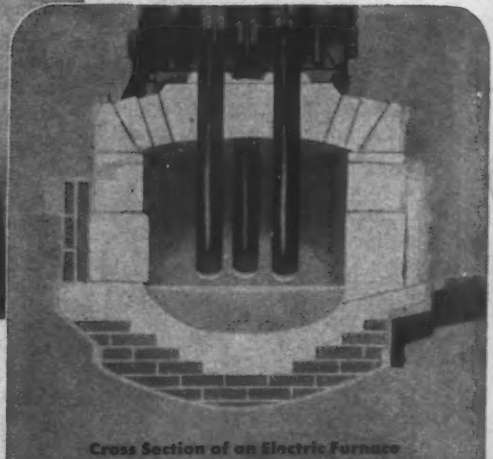
With the electric arc came heat hotter than any fire. And, by means of carbon or graphite electrodes—developed by research of NATIONAL CARBON COMPANY, INC., a Unit of UCC—man put the electric arc to work in furnaces such as the one you see above.

Born in the terrific heat of the electric furnace are many of the alloy steels used in ships, trains, planes and other equipment, and also the ferro-alloys that give strength, toughness, hardness—or the quality of being stainless—to these steels. These materials—and the intense heat that produces them—are vitally necessary to American industrial progress.

▼

Coming from the electric furnace—in addition to alloy steels and ferro-alloys—are phosphorus, abrasives, calcium carbide for acetylene used for welding and cutting, and many special alloys.

For further information write for booklet K-2, "The Story of the Carbon Arc"... there is no obligation.



Cross Section of an Electric Furnace

Electricity comes to the furnace on metal bars. It is carried into the furnace by carbon (or graphite) electrodes, which you see projecting down into a brick lined bowl. Carbon is used because, unlike metal, it will not melt.

You see carbon in many forms other than electrodes. Diamonds are pure carbon. Graphite, which is the "lead" in pencils, is carbon—and so are coke and charcoal. This material is the subject of unending research by the National Carbon Unit of UCC.

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INDUSTRIAL GASES AND CARBIDE—The Linde Air Products Company, The Oxweld Railroad Service Company, The Prest-O-Lite Company, Inc.

PLASTICS—Bakelite Corporation

Teach the boys *TODAY*... with the glue they'll use *TOMORROW*

WELDWOOD GLUE is a real craftsman's "tool". Its tremendous bonding power grips wood joints in an "invisible clamp".

By using Weldwood Glue your students develop technical skill that will be of *practical* advantage in their future trades.

Every woodworker likes it... because it saves time and holds fast.

It's cold-mixing . . . cold-spreading . . . cold-setting!

These are classroom advantages, too.

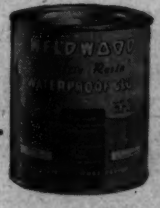
Weldwood Glue is packed in fine powder form, and mixes with ordinary tap-water to form a smooth, easily spread preparation. Sets so fast that jobs can be handled a few hours after clamping.

Stain-free and odorless, it is available in 1⅛ oz., 3½ oz., 8 oz., in 1, 5, 10, and 25 lb. cans, and in 100 lb. drums from your supply dealer.

For full information, literature and sample, mail the coupon below.

"MAKES THE GLUE LINE THE SAFETY LINE"

WELDWOOD
PLASTIC RESIN
WATERPROOF GLUE



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Please send literature, prices and sample of Weldwood Glue:—

*Name*_____ *Position*_____
*School*_____
*Address*_____
*My Regular Source of Supply is*_____

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THAT'S "SUPER"

The young craftsman may be a little "jivey" in his speech, but he certainly knows good tools. He knows they are essential to his continued progress.

For instance, there are Millers Falls Hack Saw Frames of substantial and serviceable quality with the easy-to-hold, pistol-grip handle . . . adjustable for 8 to 12 inch blades, which can be faced four ways.

And Tuf-Flex Blades, made from a new analysis steel, are super-tough, super-flexible and super-hard . . . to withstand abuse and severe strain.

It is a source of pride to the makers that so many Millers Falls tools are used for teaching. Specify Millers Falls Tools — choice of leading educators.

MILLERS FALLS TOOLS
SINCE 1868

MILLERS FALLS COMPANY GREENFIELD, MASS., U.S.A.

War Industries Training Class, Weehawken, N. J., High School, Instructor: C. Harold Billingham.

FULL OPPORTUNITY FOR MECHANICAL TALENT

The war has taught America many things. Now, more than ever, we realize the importance of educated hands as well as trained minds.

As a result, vocational educators everywhere are planning to step up the ratio of machine tools to students as rapidly as possible so that individual progress in all stages of development will not be impeded.

The photograph above shows an example of thoughtful shop planning. One lathe is stripped for use with a chuck, another is set-up for straight turning, while a third is provided for advanced practice. As the instructor states, "This is our set-up to save student time. We have 53 minute periods, so we can use plenty of teaching aids."

The demands for greater mechanical skills will continue after the war if America's progress is to be maintained. Send for catalogs and latest information about Atlas tools to help you make your postwar plans.

ATLAS PRESS COMPANY 271 N. Pitcher St., Kalamazoo 13D, Michigan

THE WORK-HABITS of a lifetime are established during the formative training years! Speed, accuracy and confidence in the use of hand tools can only be developed with *modern tool equipment* . . . the type of tools that are used in top industrial plants for production, assembly and maintenance operations . . . . *the only kind* a good mechanic will consider in making his own tool investments. To vocational schools everywhere Snap-on tool service is available through 37 factory branches. Write for catalog of the complete Snap-on line.

SNAP-ON TOOLS CORPORATION

8074-B 28th Avenue Kenosha, Wisconsin

AVAILABLE SOON!

HOUSEHOLD MECHANICS

by Bedell and Gardner

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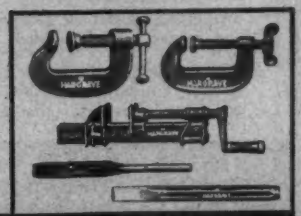

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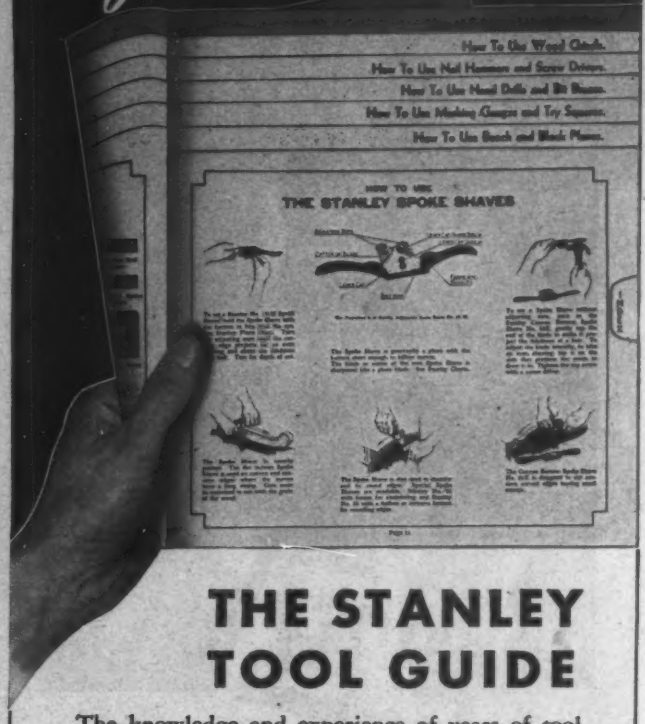
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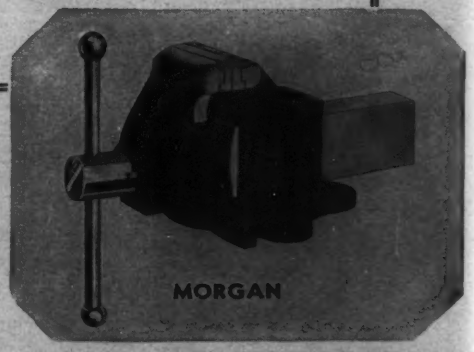

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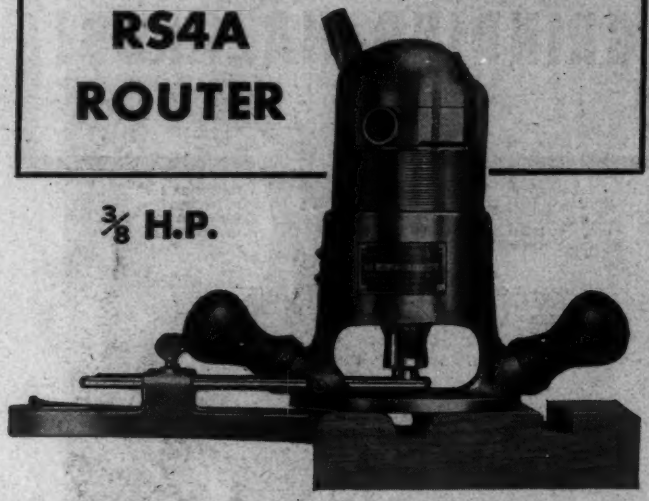

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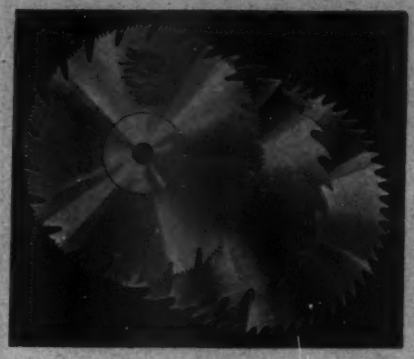

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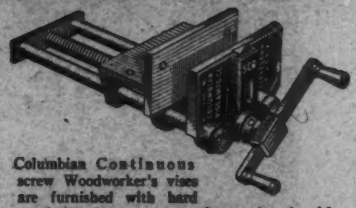

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For more information on Porto-Shears, call your nearby Black & Decker Distributor. For new 1945 catalog, giving specifications and prices on more than 100 different Portable Electric tools in the complete Black & Decker line, write to: The Black & Decker Mfg. Co., 680 Penna. Ave., Towson 4, Md.

16-Gauge Porto-Shear weighs 8½ lbs., has *universal motor*, trigger switch with locking pin. Handle can be gripped at any position, top to rear, for easy balance and control. Price ..... $76.

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In This Issue

The February issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION has been devoted especially to the problem of testing. The reader will be interested in such articles as "Constructing Achievement Tests," and "Aptitude Tests for the Machine Shop."

Besides these articles on testing there are six tests that will be helpful to teachers of diverse shop courses.

Conventions

Because of probable cancellations, it may be well to check with the officers of the educational associations listed, to ascertain whether or not a given convention is to be held on the dates originally set.

- A Conference of Industrial Education, Indiana State Teachers College, Terre Haute, Ind., has been scheduled for February 9 and 10, 1945.

  Dr. Homer J. Smith, University of Minnesota, Minneapolis, Minn., will be the conference leader, and Sylvan A. Yager, chairman, Department of Industrial Arts and Trades and Industry, Indiana State Teachers College, Terre Haute, Ind., has charge of the arrangements.

- Oklahoma Vocational Education Association convention to be held February 15, 16, and 17, at Tulsa, Okla.

  M. J. Rully, president — Director of Adult Education, Central High School, Tulsa, Okla. Bonnie Nicholson, Secretary — Central High School, Tulsa, Okla.

- New Jersey Vocational and Arts Association, meets at Chelsa Hotel, Atlantic City, N. J., March 15, 16, and 17.

  L. O. Asher, President, 275 West Northfield Ave., Livingstone, N. J.

  J. J. Berilla, Secretary, 549 Corless Ave., Phillipsburg, N. J.

  H. D. Shannon, in charge of exhibits, 1416 Miami Ave., Asbury Park, N. J.

This Month's Cover

The cover this month should remind the industrial-arts teacher that there ought to be a close tie-up between his school shop and the American Red Cross and the American Junior Red Cross.

The Junior Red Cross boy in the picture seems to say "It's fun," while he works on a toy which later on went into a gift box that was sent, with thousands of others, to the children of war stricken Europe.

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Industrial Arts and Vocational Education

THE SHOP TEACHERS' PROFESSIONAL MAGAZINE

Published monthly except in July and August

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Editorial Contributions. — The Editor invites contributions bearing upon Industrial Arts, Vocational Education, and related subjects. Manuscripts, drawings, projects, news, etc., should be sent to the Publication Office in Milwaukee. Contributions are paid for at regular space rates. In all cases manuscripts should be accompanied by full return postage.

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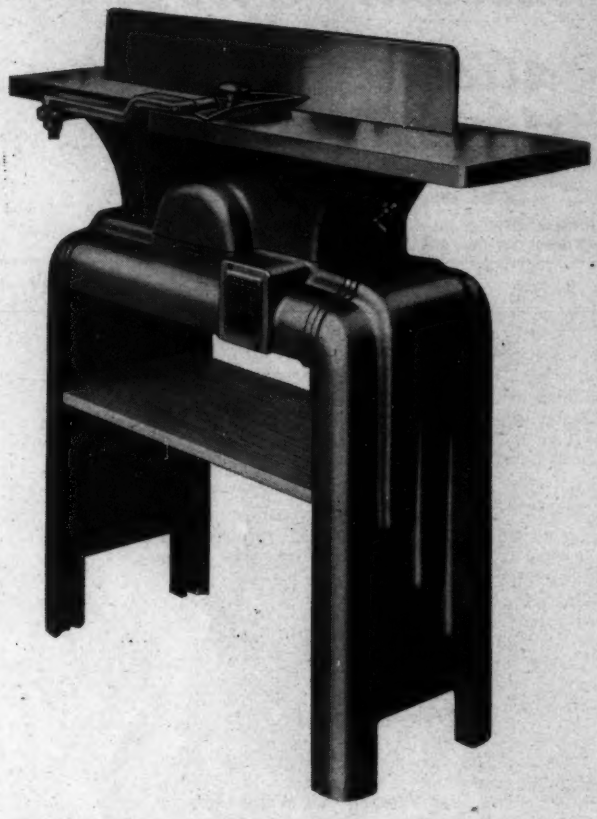
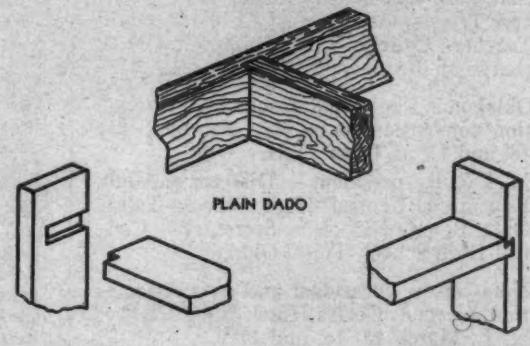


J-31

HAND JOINTER

No. 6 of a Series

JOINTS AND THEIR USES



DADO JOINT

In constructing this joint a recess is cut across the grain on the face of one member to receive the end of the other. It differs from the rabbet joint in that the recess is not cut along the end or the edge. Two variations are illustrated. The dado joint is relatively easy to make, and when snugly fit is quite strong. It is used extensively by the carpenter and cabinet maker in the construction of shelves and drawers.

In recent years much thought and attention has been given to safety when planning school shops. This is important and necessary, in fact, one prominent authority feels that safety should be the *first* consideration in such planning.

However, it is just as important that the same care be exercised in equipment selection. Too often this is not the case. Only those machines which meet the specific requirements of school use should be purchased.

To achieve the ultimate in safety, school shop equipment, especially woodworking machines, should be designed with special consideration to the size, strength and experience of the operator.

Yates-American school machines were originally intended only for school use (they have though since proved very popular in the industrial field). Consequently they are designed with safety uppermost in mind. This is especially true of the J-31 Jointer.

The base has smooth, attractive lines with no sharp corners and edges. The round, three-knife, safety-type cutterhead is well guarded at the front and rear.

High cutterhead speeds provide additional safety for the operator. Pull or drag is reduced, less pressure is required on the stock, and the danger of kick-backs is greatly decreased.

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Now is the Time to Plan for the Future

*Carl Bruner**

During this period of nip-and-tuck global warfare, when any major strategic or tactical blunder, or any major failure in the production or allocation of supplies and equipment could result in the ultimate victory of the enemy rather than ourselves, all our energies are rightfully devoted to the war-production effort. The part that an educational institution plays in this all-out effort falls, rather logically, under two or three heads. Experienced educators should be able to *organize* training procedures that result in properly skilled production workers. They should be able to *analyze*, with the help of the factory foreman, the various jobs which the workers are required to do and plan training programs that will produce new workers with the desired skills and abilities. They should be able to aid in the *selection*, by means of tryout procedures, of individuals properly qualified to do the various jobs in the plant.

The problems that will confront us immediately following the close of the war have their roots deeply entwined in the things that we do, and the attitudes we develop during the war emergency. It seems logical, therefore, that we take a little time to make tentative plans for this period of readjustment and reconstruction. Since no one knows how long the war will last, nor how completely our economic, intellectual, and spiritual resources will be exhausted, any plans that are made at this time must be subject to complete reanalysis, and possibly complete revision. Since hostilities might end suddenly and unexpectedly, a plan of some sort is essential to cover the interim between the cessation of hostilities and the resumption of peacetime living. The chances are that we will be able to do more sane and constructive thinking now than will be possible during that period of excessive exaltation that immediately follows the end of a war.

This plan should be discussed quite thoroughly with representatives of industry, both labor and management, representatives of the War Manpower Commission, the Veterans' Administration, and Employment Service; in fact, the plan should be the result of a pooling of the ideas of the representatives of all of the different agencies who are familiar with the local situation. Since the training during the postwar period will be financed by some sort of cooperative plan which would include contributions by the Federal Government, the state, and the local board of education, the whole program should have the O.K. of the local board of education. In all probability the local board should indicate by their vote if the plan meets their approval and is their anticipated solution of postwar training problems.

*Supervisor, War Production Training, Wichita, Kans.

Need for Vocational Education

It is safe to anticipate that many localities that have become more highly industrialized because of the war will remain industrial communities to a degree not even dreamed of a few years ago. Most of the new citizens who have come to these towns are engaged in some productive job where they are using mechanical skill. Many others who have lived in the community for a longer time have transferred from commercial jobs, odd jobs, or farming as a method of earning their living to some mechanical type of work. All of these people now have been trained along industrial lines, either prior to entering production or after they were on the job. Many thousands of them have taken supplementary courses which tend to make them industrial minded as well as giving information, skills, and interests in the industrial field. In fact, this reservoir of trained individuals, plus those who will return to the community from our highly mechanized armed forces, is likely to attract industrial enterprise to the area which will, in turn, add further impetus to the industrialization of the area.

There are many indications that some of these cities that have become air minded as a result of the war will continue to develop as air centers. Probably aircraft manufacturing, maintenance activities, and general use of airplanes will continue to grow in most sections of the country. Most of the larger aircraft plants have ambitious peacetime programs. In addition to the large commercial types of planes that Boeing, Douglas, Lockheed, and others will build, there will be many plants working on pleasure craft. It seems reasonable to suppose that there will be a brisk demand for the training of pilots, training for the various branches of aircraft maintenance and repair, and continued training and retraining for the various manufacturing departments in the factories.

To some extent each of these types of training provides material for the other branches of an all-round training program for the aviation industry. The planes needed for the pilot training program have to be serviced and repaired, and thus form the nucleus for maintenance and repair activity. Both of these branches of training add interest and meaning to the work done by the trainees planned to enter the factories as production workers.

Educators have been fortunate in having had an opportunity to learn how to train for a rapidly expanding aviation industry by actually doing the job. Long before funds became available under the National Defense Training Law, groups of men were hard at work in the school shops, learning the skills and information required of an aircraft worker. This training was started frequently at the request of the airplane plants on the theory that, from a long-range point of view, it was better to train local people for local plants than to attempt to import trained workers from other areas. The wisdom of this theory has been proved many times since the nationwide war stimulated shortage in man power has developed. While it is true that this was short specialized "job" training rather than vocational training in its wider sense, much was learned that can be used in a realistic postwar training program.

All details of the school setup, including objectives, skills needed, and amount of training necessary, were in most localities worked out in close cooperation with the factories. The organization was kept flexible so that methods and scope could be corrected as results of the training were observed.

Many thousands of workers have been trained on a preproduction basis and many thousand more have increased their effectiveness on the job by enrolling in supplementary classes in these war-training setups.

The problems of the future should bear some resemblance to the ones that have been solved in the training of these workers. Habits have been developed which have proved successful. The habit of checking in a careful and systematic manner all angles with the factories, with the state department of vocational education, with the local board of education, and with other interested groups, should work on any vocational program; a realistic approach to the problems of job analysis and course of study preparation should add to the vitality of any school setup; and the flexibility that has been made necessary

by war emergency needs could and should carry over into peacetime operation.

Some Basic Assumptions

There are some basic assumptions which form the core around which we can build our plans.

1. If training needs to be done, it should be done by those who have the experience, education, and ability to do the job.

2. There will be a period of readjustment following the cessation of hostilities that will affect the mode of life and means of making a living of everyone in the country.

3. There will be some shrinkage in the volume of products produced by some of our plants that are now working on government contracts but there are indications that industrial production will remain at a high level.

4. A great deal of training will be necessary to aid people in making the transfer from a wartime economy to a peacetime job; they must be prepared for their new job.

5. Many persons have had highly specialized types of training which gave them the skills necessary for some specific job in the war effort. These people will have to be given a broader and more general type of training to equip them for their peacetime occupations as producers and buyers of civilian goods.

6. In all probability there will be keener competition for the fewer jobs, so more complete training will be necessary.

7. A part of the students in the regular school should be kept in training until the age of 21 or 22 so they will have sufficient maturity to accept the responsibility of running a high production machine.

8. Training facilities and schedules should be offered which would make it possible for anyone to take a short unit course at any time during the day or night to meet specific specialized requirements in certain occupations.

9. Vocational rehabilitation training will probably be needed. This will include the training of those incapacitated by war and those whose jobs have disappeared or changed because of technological advancement.

10. The training program should be kept flexible so that individual and industrial needs can be taken care of. What, when, where, and how much, are questions that apply to training programs as well as to other activities.

11. Active contacts should be established and maintained between the school and industry through advisory committees, etc., so there will be no chance for a gap to develop between what the school is doing and what industry needs. There were indications that a gap had been allowed to develop in the prewar period which gives an excuse for special agencies to be instituted.

12. A terminal course of junior college age level should be provided for those who are not going on to get their college degrees, and for those who prefer industrial and scientific training.

13. A large number of soldiers will find that their former jobs will no longer be available and will have to be trained for entry to new occupations.

14. Many women who are now taking men's jobs in industries will have to be retrained for the more conventional feminine pursuits, such as stenography, sewing, cooking, and the like.

Characteristics of the School

While many persons could be found who would disagree with the following suggestions, there are many vocationally minded men in the manufacturing industries and in the schools who would like to have the training program take the following general lines:

Enrollment: The program must be entirely flexible. It should be possible for a trainee to enroll at any time for a unit of work which will help him on his job, or prepare him for the next job ahead. Prerequisites should be held to a minimum, although some units of work, in all probability, would have to be arranged in order of difficulty. Departments of the school should be free to expand or contract as the need for that particular kind of training fluctuates in the community. School authorities should be free to organize courses, scheduled for any hour of the day or night, and for any length of course that the problem at hand seems to indicate.

There should be few interruptions of the program, such as assemblies, athletic contests, musical events, special contests, and the like.

Instructors: All instructors should be of recognized skill in the field of work for which they are offering training. The instructor's experience in the factory should be recent, and if he is employed for any length of time, provisions should be made for "refresher" contacts and information. In all probability this should consist of more than a visit to the plant.

The first and major requisite to be considered when selecting instructors for this program should be the degree of mastery of the skills and information required for the successful "doing of the job," which is to be taught. Personality, experience both as teacher and workman, and academic background should be carefully considered, but none of these traits or qualifications should be substituted for sufficient "doing ability" to insure the respect of the factory workman.

A reasonable amount of turnover is an advantage since it results in recent factory experience being quite common in the teaching staff. If the proper type of individuals have been selected as instructors, the voluntary return to productive jobs in the factory results in a selling effect for the vocational training program that is entirely wholesome.

For part-time classes it is best to use factory personnel, but the supervision and control of these part-time instructors should remain with the schoolmen to check against bad teaching practice.

Adequate salaries should be paid so that men of sufficient caliber to do the job will be attracted to the school.

Vocational instructors must be "on their toes." The instructor must read, visit the factory, and confer constantly with the factory men or he will become a back number, and will develop special "school ways of doing the job." Too much improvision or special school methods can easily do a great deal of harm to the value of the training.

Physical Setup: The atmosphere of the factory should be duplicated as far as possible. Materials and tools should be the same as those being used in the factory for which training is being offered. The school should use the latest approved methods of doing every job. Trainees should be encouraged to take related work that will help them on their job, but as much related work as possible should be eliminated from the unit course, and only the related technical information that is absolutely essential in order to do the job should be required.

Separate Trade School Unit (not a department of an academic high school): In all probability the trade school should be organized as a special unit, and not be attached to an academic high school for several reasons:

a) If attached to an academic high school, the instructors would be required to have an academic background sufficient to meet the requirements of the North Central Association, while in a trade school the demonstrated skill, and factory experience would be the prime requisite for employment.

b) It is difficult to arrange a flexible program when attached to an academic high school because of the strong tendency to enroll in September and graduate in June.

c) When attached to an academic high school, it is difficult to make effective use of all of the hours of the day and night that a good vocational training program might require. The tendency to start at eight and close at three-thirty or four is difficult to overcome. While in a trade school many of the most successful classes are held at nine or ten o'clock in the evening.

d) When attached to an academic high school, it is difficult to discourage the participation by the vocational trainees in all of the various school activities, such as sports, music, etc., without inviting the antagonism both of the trainees and teaching staff of the academic high school.

Units of Work: The course of training should be as short as possible to accomplish the desired result, and yet long enough to make sure that the trainees can reach the standard of efficiency promised the factory. All of the courses should be organized in comparatively short units. These short units tend to add to the interest of the course, and the accuracy with which certain results are accomplished. Short units also contribute to the ease of taking care of individual differences. Units of work should be organized and arranged in a sequential manner so that a complete

course of possibly two years in length could be offered to those who desire such training. An individual who needs the work should be allowed to enroll for any unit for which he has sufficient background of experience to give promise of successful completion. No course of training should be started for any factory or for any group of workers without a careful analysis of the problem at hand, and a complete agreement between the factory and school on what is to be accomplished. The ideal training school should be operated in a manner similar to a cafeteria in which the factory, or the trainee, or both, could come figuratively to a counter and select that unit of education or training that is needed for the successful prosecution of his task. Every means at the school's disposal should be used to discourage the idea that a person is ever through with school, or ever through with training. The school should be a center frequently used by people of both sexes, and all ages, to aid them in the accomplishment of their various tasks.

Promotional Plan

Frequently school people "view with alarm" the parallel, overlapping, and conflicting educational activities developing in the various federal agencies. Educators should honestly ask themselves the question "have these activities originated because the schools did not move fast enough?" America has grown and prospered because we, as a people, did not wait for things to be done by the recognized experts. Jobs that need doing will be done. If we are "on our toes" we can make our contribution by doing the job. If we are not, others will attack the problem and the solution might not be to our liking.

A plan for an industrial and vocational training program should be written up and thoroughly discussed by interested groups in the community, including committees of the Chamber of Commerce, manufacturers' associations, unions, etc., also, various groups from educational departments of the various factories and community enterprises that might be interested in using the training.

After a plan has crystallized that gives promise of working rather successfully in the postwar period, this plan should be presented to the local board of education, discussed thoroughly by them, and if possible be adopted by them as the tentative plan to be followed in the community to take care of its training needs.

Armed with such a resolution by the board of education, those interested in the promotion of industrial education could be spotting units of floor space, production machines, source of material, supplies, etc., that would be available either now or as soon as an armistice is signed.

The Industrial Committee of the Chamber of Commerce, the Manufacturers' Association, and other groups are making ambitious postwar plans. The public schools should have their training plan ready to take proper care of the training needs as they become apparent in the development of these programs.

Preinduction Training in the Field of Industrial Education

*Daniel H. Shay**

It is not the purpose of this article to establish that preinduction training of a strictly vocational nature is necessary or indeed that it is desirable in the interests of helping to win the war. That it is very desirable from the army's standpoint is the opinion of responsible army officers. That it is very helpful to the prospective inductee has been widely stated and, I think, generally accepted. Responsible officers of the army have repeatedly pointed out the need and the wisdom of giving to our young men who are in the age group from 16 to 18 years of age some organized vocational training in those skills which the army particularly needs. It is generally understood that approximately 90 per cent of the army's personnel must be trained in varied technical skills to fill army specialist jobs.

In the years 1941 to 1942, large numbers of inductees came into the army with varying amounts of industrial and mechanical experience gained through employment in industrial and mechanical occupations. This trend is no longer true. At present, a large proportion of the replacement requirements of the army are coming from school youth as they become 18 years of age.

Most of these youth now being inducted have had little or no industrial employment experience. Our school records give painful evidence that a very small percentage of them have had any vocational or industrial-arts training in their secondary educational program.

Since we must accept the inevitable, though regrettable, fact that all our boys 16 to 18 years of age now in our schools, if physically fit, will be inducted into the armed forces, and that approximately seven out of eight of these will be in the army, a very grave responsibility rests upon the school people accountable for the education of these youth. What can the secondary schools (high and vocational) do to help in this situation?

To answer the question of what the secondary schools can do to meet the needs of the youth in their charge, the actual plan of development in one state is presented in this article.

Early in 1943, Massachusetts, under the leadership of the commissioner of education, Dr. Julius E. Warren, tackled the problem of utilizing all the available resources of secondary schools to provide, on a vocational level, all possible preinduction training for those between the ages of 16 and 38 years who could and would avail themselves of the opportunity.

In order to reach and serve as wide a group as possible, a state-wide advisory committee on war-production and preinduction training was appointed by Commissioner Warren. This committee was made up of representatives of the Massachusetts School Superintendents Association, Industrial Education Association, High School Principals Association, Massachusetts Vocational Association, and directors of vocational schools. In addition, the commissioner and six Massachusetts Department of Education staff members, along with special consultants including the chief, Preinduction Training Branch, First Service Command, principal of the Newton High School, and director of the Newton Vocational School have been active in this field. The latter two were selected because of the model "interschool" high school-vocational school preinduction training program in effect since 1941.

As co-ordinator of this preinduction training program for the Department of Education, the associate director of vocational education, Dr. Robert O. Small, has at various times called together superintendents of schools, high school principals, and vocational school directors to meet in several different areas of the state to discuss the need for preinduction training and to plan ways and means through which this need in the area covered might best be met.

Those boys now enrolled in the state and federally aided trade schools are already receiving, in addition to trade training, the best type of preinduction training for the needs of the army. Boys enrolled in well-equipped technical high schools, too, have available to them an opportunity for most effective preinduction training. However, for the many thousands of boys

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enrolled in the small high schools with inadequate or no available equipment, the problem of how an effective vocational preinduction training program may be organized and financed is not always simple.

There are several possible solutions to this problem of providing vocational preinduction training to high school boys over 16 years of age:

How to Provide Vocational Preinduction Training

1. Arrangements through which these boys may receive approved shop instruction for a minimum of 15 clock hours per week in a trade school, and at the same time carry on a planned though curtailed program of other studies in regular high school classes, such as English, history, and mathematics.

2. Arrangements through which these boys may carry on a regular high school program and in the late afternoon attend a trade school for shop instruction of 15 or fewer clock hours and, of course, receive additional credit for the extra work.

3. Arrangements through which these boys may carry on their regular high school program and attend vocational preinduction classes in the evening for 15 or fewer clock hours of instruction and receive additional credit for the extra work.

4. Arrangements through which these boys may transfer from the high school to the trade school for all or part of the senior year and receive full credit toward their high school diplomas.

There are other arrangements through which the preinduction training problem is being solved which we have not been able to approve as vocational. Massachusetts has used all of those above listed with, we believe, considerable success, and has given financial aid under the state and federal laws and official rulings governing the use of state and federal vocational funds.

Vocational courses organized for at least 15 clock hours per week, giving training in occupations approved by the state director of the War Manpower Commission, have been paid for in full from federal funds appropriated for vocational training for war-production workers. The youth (over 16 years of age) who take these courses not only receive the most effective preinduction training, but they actually use this training through employment for a short time in war industries, thereby gaining additional experience and confidence in themselves. By so doing they contribute more effectively to the war effort.

Vocational courses organized for fewer than 15 clock hours per week have been organized under the provision of Miscellaneous 3084, U. S. Office of Education, November 25, 1943, as "part-time trade preparatory courses" and financed in full (as to salary of teacher) from federal part-time (George-Deen) funds.

Where the entire cost is paid from war-production training funds, there can be no question of residence either within or without the state; where federal part-time (George-Deen) funds are provided in full for the payment of salary of the teacher, no nonresident tuition is approved since the salary of teacher is approximately 70 per cent of the cost of the course.

The chief of the Preinduction Training Branch, Military Training Division of the First Service Command, has been most helpful in aiding schools through many personal talks to groups of senior boys, and through suggestions as to available literature, posters, films, handbooks, and pamphlets. These latter are most effective as teaching aids and subject matter outlines.

Where to Get Help in Solving the Problems

In addition to rendering invaluable assistance in teaching aids and subject matter, the preinduction training officer has been of great assistance to the schools in helping them to secure through proper channels salvaged equipment and material which have added much to available equipment in the schools.

The Vocational Division of the Massachusetts Department of Education, with the help and cooperation of a special committee of directors of vocational schools, has worked out concise courses of study in airplane mechanics, auto mechanics, electrical shop, electrical signal communications (radio), machine shop, pattern-making, sheet-metal work, and welding for vocational preinduction classes in those occupations which can best contribute to the training needs of the army.

According to a report of Headquarters, First Service Command, based upon a survey conducted in May, 1944:

1. Thirty-six Massachusetts vocational and trade schools during the school year 1943–44 gave vocational preinduction training to 5781 boys enrolled in 83 vocational courses adapted according to War Department recommendations to meet army needs.

2. Twenty vocational schools served 39 different high schools in an approved plan of high school-vocational school preinduction training programs with a total of 1568 boys. These boys retain their high school status but spend from 4 to 15 hours per week in a vocational course.

3. Thirteen vocational schools and seven high schools offered preinduction training courses for out-of-school men aged 18 to 37 years who faced induction into the armed forces.

With increasingly good war front reports a strong feeling of optimism concerning the early termination of hostilities resulted in many boys changing their minds over the summer months concerning enrollment in special preinduction courses. Vocational schools reported a drop in enrollment of part-time students from nearby high schools.

At present there are approximately 1000 high school students enrolled in 19 courses in 17 vocational schools in Massachusetts. This number will increase when the fact is fully accepted that the war is not really over and that every boy of 16 years (and perhaps those now 15 years), if found to be physically fit, will eventually be inducted into one of the several branches of the armed services.

The youth now in our schools look to us for guidance and help to prepare them for the difficult and dangerous job which surely lies before them. The needs of youth preparing to serve in the army as presented in the War Department Bulletin PIT-1, "Essential Facts About Preinduction Training," are (with the possible exception of "Orientation to Army Life") the needs of every American in peace as well as in war. The focus is upon the basic essentials and objectives of sound education.

It has not been suggested that we scrap the regular secondary program and substitute something else. Rather, it has been suggested that a careful review of our subject matter will disclose ways in which we can change the emphasis of the courses which we now teach. These youth are not preparing for college — yet.

What is Good Teaching?

*Charles S. Siskind**

We have been at the business of teaching, both privately and publicly, individually and in groups, youngsters and adults, for a good many centuries. The methods we use to transmit information and to provoke sane thinking habits have been altered from time to time in accordance with *newly developed* techniques in the classroom, shop or laboratory. *New* psychologies have replaced old ones just as new charts, mechanical devices, demonstration equipment, and machines have been substituted for apparently outmoded, obsolete teaching aids. But strangely enough all of this so-called "progress" has not advanced us much closer to our phantom ideal, that is a goal which develops the best inherent capabilities of all students.

To put it bluntly, we just do not seem to know what constitutes good teaching in the sense that we can, or are willing, to set down definite rules and procedures for one of the most important of our functions as human beings. There are so many different educational schools of thought,

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even concerning the most elementary rules of conduct that, viewing the matter from the standpoint of a science, we can scarcely say we have advanced very far considering how long we have been at the job. True, the tremendous variety of patterns constituting the "clay" we must "mold" makes this a particularly difficult task, but it is nevertheless a strange indictment against our profession when we are forced to admit that we stand on very little common ground. It is only necessary to visit the classrooms, shops, and laboratories in some of our schools, observing the apparent confusion, lost motion, and wasted time, to realize how absurdly we administer to our students during the most important period of their lives. Frankly, education in this country is virtually planless when we consider how poorly equipped are our "graduates" from the high schools and colleges. The very fact that a substantial percentage of our entering college freshmen haven't a ghost of a chance to graduate because of their poor preparation is ample proof that our high schools have been derelict in their teaching jobs. Even industry must begin retraining the "cream" of our youth after the schools of higher learning are willing to bestow the "seal of approval" upon them. Apparently, after we, as teachers, are through with our charges, after we have discharged our most sacred duties, we are not only willing to admit that the business and industrial world is ready to start the special educational processing, but do very little to prevent a continuation of these confusing practices.

Recognizing the Good Teacher

Nevertheless, in spite of this gloomy picture, there is always a good deal of *good* teaching going on. And strangely enough it is not particularly difficult to recognize a good teacher in action, even though the fine qualities which produce a high grade performance on the lecture platform, in the classroom, or in the laboratory or shop are somewhat indefinite and illusive. Most of us have seen extremely well-informed men and women leave their students blank with despair and often in a considerable state of confusion. On the other hand it is also true that some exceptionally fine teaching has been, and is being, done by teachers whose fund of information, technical ability, and manual skill are just short of mediocre.

Generally speaking it may well be said that a teacher has not *taught* well until his students have *learned* well. This does not necessarily mean that all individuals in a class "have been reached" to the same extent, for obviously such finality would disregard mental inequalities, differences in interests and innate technical and artistic qualifications. But it does imply that the teacher and his students have met on common ground to study and discuss vital problems, and that every student has profited to the limit of his intellectual, technical, and artistic abilities. To the extent that this illusive 100 per cent achievement has not been attained, to that extent has the teacher failed in his mission.

Aside from the important function which must be played by the personality of the teacher in this teaching and learning relationship, it is also important to consider the availability of physical equipment. This is especially true of shop and laboratory courses of instruction. Even the best teaching is handicapped and sometimes irreparably damaged where tools, machinery, supplies, and demonstration equipment are either unavailable or, when available, in a poor state of repair. Certainly if laboratory and vocational shop teachers are to meet high standards of attainment it is essential that classroom instruction, dealing with fundamental principles of the major course, as well as any related technical and nontechnical subjects, be supplemented by effective training of manipulative skills upon modern machines and equipment. Whereas the services of good instruction is often unavailable, no matter what price is paid for it, this is not ordinarily true of the purchase of machinery. A well-equipped shop or laboratory supervised by well-trained, efficient personnel is one of the best insurances against inefficient instruction.

What Teaching Requires

Teaching as a profession requires primarily that its members be intensely animated by a desire to impart knowledge, arouse interest and curiosity, develop logical thinking habits, and otherwise inspire students with an inclination to become useful members of society. To fulfill this lofty ideal it is essential that a teacher develop in his students a high degree of loyalty, respect, and even reverence for the good things of life. To this end he must not only become expert in his specialty, but should have a reasonably good understanding of those subjects which may be directly or indirectly related to it. Forceful presentation demands a good command of grammatically correct English, and a proficiency in demonstrating by blackboard sketches and experiment those phases of a subject, particularly of a technical nature, which might otherwise be clouded by the mere making of sounds. A good teacher is a good deal like a research scientist because he is always "seeking new and more effective methods" to guide the thinking habits of his students. As experience widens his circle of effectiveness, he begins to sense instinctively how the youthful mind reacts to new ideas and problems and what limitations may be reasonably expected.

This discussion leads us finally to the question, "What are the functions of a good teacher?" Obviously, no simple answer can be given to what appears to be a simple query. The author has, however, thought a good deal about this matter, and, over a period of years of practical classroom and laboratory instruction, has arrived at some rather definite fundamental "principles" concerning his own particular field of electricity. Without pretending that these would apply to all branches of learning, or that other "principles" might not apply equally as well, they are summarized below.

To function well, a good teacher:

1. Should give information, (*a*) directly in class discussions, (*b*) in lectures, and (*c*) in physical demonstrations on actual and laboratory equipment and devices.

2. Should stimulate logical thinking habits, (*a*) about the immediate subject matter, (*b*) about fields related to the one being studied, and (*c*) by suggesting interesting questions and problems concerning well-known phenomena.

3. Should arouse interest and curiosity so that students will *voluntarily* read and study unassigned books and magazines. Casual remarks about good references and a well-balanced library arranged for *service to students* are excellent stimulants.

4. Should simplify apparently complex ideas, (*a*) by generalizing, (*b*) by discussing theoretical equations and principles in terms of "common-sense" experiences, and (*c*) by suggesting numerous practical illustrations.

5. Should improve the manual skill of his students, (*a*) by employing worthwhile, high grade laboratory and shop equipment in the performance of experiments and shop jobs, (*b*) by setting up high standards of performance, and (*c*) by personally becoming exceptionally well skilled so that he can serve as a model and inspiration to his students.

6. Should stimulate the imagination, (*a*) by discussing the evolution of modern devices, machines, and equipment, (*b*) by suggesting improvements in existing constructions, methods, and ideas, and (*c*) by making statements from time to time about unsolved problems and existing difficulties.

Courses of instruction of a scientific nature such as physics, chemistry, and the broad field of electricity are commonly planned to emphasize well-established physical principles and laws. To do this most satisfactorily it is generally recognized that the most advantageous procedure involves a combination of (*a*) lecture and classroom discussion periods, (*b*) laboratory and shopwork with and upon actual apparatus and machines, and (*c*) demonstrations given by the instructor to groups of students. When these are properly co-ordinated so that the same topics are studied simultaneously in all three divisions of the subject, students are likely to be more keenly interested and to learn more readily. It has been the author's experience that when a subject *appears* to be simple, no matter what educational "tricks" are employed to make it so, there is a greater degree of absorption, as well as an urge to progress intellectually, than under conditions of difficulty. In fact, it should always be the teacher's aim to encourage by simplification rather than to discourage by complication.

Learning by Doing

Scientific learning should be coupled with practical experiences since this always tends to amplify the very laws and principles which fundamentally underlie the

operation of real devices and machines. As soon as students are made to understand that a real science makes *prediction* possible, no matter how complex are the elements of that prediction, the sooner will they be impressed with the fact that from the standpoint of education, the governing laws and principles are much more important than the things themselves.

Much has been written concerning classroom, laboratory, and shop practices. Normal schools in their various courses in education and practice teaching devote much time to these phases of their work. Unfortunately, however, little has been done to improve the demonstration method in the teaching of scientific courses although it is actually one of the instructor's most powerful tools. True, a good deal of demonstration is carried on, but here again it is felt that much improvement is necessary if this method is to be as effective as it can be. A well-organized demonstration in which good, though not necessarily expensive, equipment is used, and given by a forceful personality, can do much to dispel notions about the difficulty of understanding a science. A good performance can be at once entertaining, stimulating, and instructive.

The Demonstration Lecture Method

The author has devoted much time to the demonstration-lecture method in his work as a teacher of electricity and has developed not only many kinds of useful pieces of equipment and "gadgets," but also some rather definite teaching devices and aids. These are listed in the following paragraphs.

1. Always illustrate some law or principle. Emphasis should be placed upon their fundamental importance, never upon the application or operation. This should be done by first stating the law or principle, writing it upon a blackboard, or having large printed cards plainly visible to everybody while the demonstration proceeds.

2. Always set up the equipment from the individual parts *in front of the students*. Be so perfectly familiar with every detail of the assembly that the work is carried on casually. The student should be made to feel that the very simplicity of the construction would make him just as competent as his teacher in setting up the apparatus.

3. Every demonstration should be discussed in connection with the application of the law or principle to some known practical device or machine.

4. Always be impersonal. The students' attention should be centered upon the apparatus, their eyes focused upon what is happening; never should the demonstrator be the center of attraction.

5. The equipment preferably should be crude and simple. All parts should be plainly visible so that their construction is clearly understood.

6. Be sure the demonstration always works the first time. This means that the demonstrator should do everything carefully in advance; he should know exactly what to do and what to expect at every step of the demonstration.

7. The student should be made to feel that the experiment is being done for the first time for his personal benefit. The demonstrator should try to make it appear that he, too, is learning something new. Use the words *we, us, our*, etc., occasionally.

8. Demonstrate for the student in the rear. If the interest of those farthest away is obtained it may be presumed that those in front will get the full significance of the experiment.

9. The demonstrator should raise questions as he proceeds, looking to the students for answers. Be sure such questions are simple, although they become progressively more difficult. Suggest hints and possible answers from time to time, but always try to avoid giving a direct answer to a given question.

10. After the equipment is properly assembled, and before the demonstration proceeds, have the students try to *predict* what will happen. This practice will stimulate good thinking habits.

11. Know your audience. Use language, illustrations, and examples with which your students are familiar. Be clear, repeat important points frequently, and define all new terms. Above all, talk to your students, not to the apparatus or the blackboard.

12. Whenever possible, have the assistance of one or more students while performing an experiment. Students like to feel they are playing some part in the "show."

13. The historical background of important principles should be briefly discussed as demonstrations proceed. These comments should include important dates, figures, human incidents, and other worthwhile related fields of science. Discussions of this sort always stimulate the imagination.

14. Use a minimum of calculations. Always try to demonstrate on a qualitative basis. Avoid quantitative analysis whenever possible.

15. Refer occasionally to statements and figures used in the students' texts. To encourage voluntary outside reading, it is also desirable to mention good, supplementary reading matter in magazines and other books from time to time.

16. Never become involved in an argument with an individual student. This wastes class time. Always talk to the entire group as a whole. And above all, avoid making remarks of a personal nature.

17. Encourage students to come up after the demonstrations to examine the equipment, and try to influence them to make their own models and pieces of equipment. Offer your help where this is possible.

It should be clear from our discussion that a *good* teacher is an extremely versatile individual because his profession demands unusual qualifications. He must not only be well informed, but must be capable of transmitting information clearly and well. He must not only be a good craftsman but must likewise be capable of developing the skill of others. In addition, he must be a practical psychologist, for he should be able to bring out the best in the varying abilities of his students. A good teacher commands the respect and admiration of his students only when he has become their ideal, and in truth their friend.

The Designer of Today

*Bernard J. Wolfe**

Rapid strides have already been made in the design of both product and production machinery, but it is very evident that we are entering another era in the development of new automatic devices and machines.

In the postwar years, it will be the designer who must create these new devices and machines to bring about higher living standards. Foreign competition will be an ever increasing problem as foreign countries are gradually adopting our modern production methods.

In normal times, even in some of the slack periods, there is a shortage of skilled as well as unskilled labor. After the cessation of hostilities the worker will once again be looking forward to a shorter working day, and it will be necessary to increase our production to maintain our higher living standard. This forces the manufacturers to look for new ideas in engineering and production methods, all of which eventually becomes the problem of the designer or development engineer.

One of our first and foremost problems is the training of more designers. Too many of our young men today are discouraged when they learn what they must go through to obtain the necessary training and experience required of a designer. Very few of them want to serve an apprenticeship in the machine shops. After a thorough technical training there isn't anything more valuable than this machine-shop work. After the apprenticeship several years' experience as a mechanic on the actual problems arising every day are of utmost importance.

What are the problems facing the designer?

Laborsaving machinery of all kinds have already been given the unskilled worker.

*Scientific Bureau, Bausch & Lomb Optical Co., Rochester, N. Y.

More laborsaving machinery must be given the skilled worker. He must meet the scarcity of skilled labor by designing more automatic machines requiring fewer operations. He must bring about radical changes in the design of a large number of present-day machines and mechanical tools, and he must design new machines. Since approximately one third of the worker's life is spent in industry, the question of fatigue and of the worker's comfort should be important factors in design. The designer must use foresight so that there is a market for the product when it is completed, and his designs must embody timeliness, accuracy, simplicity, and adequacy.

Qualifications

The qualifications for a good designer are: A good scholastic training followed by an apprenticeship training course in a machine shop or experimental model shop. This type of training will be found an invaluable asset to the experienced designer. It will give him an idea of what can be done and what cannot be done practically, from a production standpoint.

Pattern Shop: Another important consideration is the unfamiliarity of many designers and draftsmen with pattern shop and foundry practice. The work in the pattern shop should be followed closely. Very often a slight change in design will save much labor in the foundry.

Foundry: External cores are the first sign of weakness. Elimination or reduction of internal cores also should be given consideration but only with the cooperation of both the foundry and the designer. Foundry costs increase with the number of cores. Hand parting and pasting, also pockets and uneven edges contribute considerably to foundry costs and poor appearance of the finished product.

Open-mindedness on the part of the designer is most important. The foundryman must not only be heard and listened to, but must be tempted to discuss his ideas. Perhaps a small modification might permit the development of new foundry practice. Reducing weight by diminishing the wall thickness is usually the first resort of the designer, yet actually this is the one place where weight should not be reduced unless the wall thickness is too heavy for good foundry practice.

Light walls entail every kind of foundry loss and are the source of all kinds of machining troubles. If weight is to be reduced, it must be done by shortening walls and eliminating parts or by designing less weight into the product.

The designer seldom feels that it is within his province to help in producing clean castings. No doubt, good foundry practice goes far in producing such castings, but the designer who cooperates with the foundry in this respect can help a great deal.

Designers have been notorious for their neglect of foundry consideration. The designer must bear in mind that castings are virtually being assembled in the liquid state within the mold. This principle, when borne in mind while producing a design, will obviate unnecessary projections and uneven sections.

One does not expect a designer to be a foundry expert, but he should know how his design can be cast economically, and possess proper draft and as few cores as possible.

The designer should not fail to discuss his design with the foundry officials. Frequently he may get suggestions in this way that will affect the cost considerably. It is important also that the foundry be given the opportunity of making sufficient experimental castings before proceeding with a production lot. Some of these should then be cut up or X-rayed to determine whether or not the casting is free from porous sections and whether or not the wall sections and thicknesses are as expected.

This will also determine whether the core has shifted due to faulty design or pattern construction. When a casting that has been cut up is found to be perfect, it can be machined with greater assurance that a more faultless product can be obtained.

It is well for the designer to go into the foundry once every six months and become familiar with the latest practices and keep them in mind on all future designs.

It has been the writer's experience with many manufacturers that castings are usually bought at the lowest obtainable price. This invariably is a poor policy; cheap castings usually possess poor machining qualities. Better castings may cost more but the difference in price may be more than justified in the saving effected on the machining operations. Good castings also require less cleaning and touching up for outward appearances, thereby saving considerable in lacquering and finishing costs.

A common error often made is to neglect to allow sufficient clearance for screw heads, bolts, and for assembling or for making adjustments. This error also is commonly made on forgings and should be considered.

Design

The designer must be sure that any new design is based upon correct engineering principles and that the machinery or apparatus made from these designs will be reasonable in cost and economical to maintain. Fads and prejudices must be avoided as far as possible. The design should not be rushed to completion at the expense of poor design. Elimination of parts, combining two or more mechanisms into one, elimination of mechanisms which are not positive, and standardization of parts and mechanisms should be a rule every designer should adhere to. This sometimes reduces the total number of parts by 25 per cent, but even if the reduction is only 3 to 5 per cent, it means a very substantial saving in manufacturing costs, less material required, and less labor for machining, assembling, and handling.

It is always preferable to figure the strength of the various parts that make up the mechanism rather than to guess at sizes. This should be observed especially when designing shafts, bearings, cross sections of frames and supports, and springs. Very often machines break down under normal working conditions and this can usually be traced to insufficient strength of material. Designers frequently make the remark: "Why bother to calculate; let's make it heavy enough to be sure it will stand up." This method costs more than does the time required to figure sizes accurately, for an extra ounce of material in every machine, or on a given part, will soon amount to a considerable item.

Advantage should be taken of available standard parts or units that can be purchased at reasonable prices, and use them rather than spending time in designing similar special screws, bolts, and the like.

Designing for Use

Design machines which are easily operated. Keep in mind the comfort of the operator in the arrangement of hand and foot levers and controls, and the like. Placing of control levers should be arranged to fall in with the natural movement of the body. The machine should also be so designed that it cannot be easily thrown out of adjustment. Mechanical movements which are not positive are a constant source of trouble. One example of this is the use of tension springs. Unfortunately in most spring applications where fatigue problems are particularly severe, accurate stress calculations cannot always be made from a mere knowledge of the range of loads or deflections to be encountered. It is apparent from the foregoing that the designing of springs for maximum fatigue resistance is a problem embodying many complexities.

It is always preferable to use a compression spring from the design point of view. A tension spring means the existence of a definite stress in the spring wire in the original undeflected form of the spring before its action is put to work.

Guard all openings and movable parts and incorporate wherever possible the guard as an integral part of the machine or apparatus.

Makeshift guards often cost more than those designed as a part of the machine, because the attached guards are easily removed and frequently are the source of serious accidents. Properly guarded machines also prevent mischievous tampering and promote safety.

Feature automatic lubrication. It is becoming more important every day to automatically lubricate all bearings and frictional surfaces. On semiautomatic machines or hand-operated devices where automatic lubrication is not possible, a central lubricating point should be provided from which all frictional surfaces are fed. On high-grade machinery, especially those using ball bearings, provision should be made for filtering the oil from the reservoir before it reaches the bearings.

The writer has had occasion to visit some plants using high grade special ma-

chinery for quantity production, especially in places where operators are principally women and unskilled labor. In some of these places, the oil can is almost unknown and the cost of maintenance and replacements is of no little consequence, whereas if the machines were automatically lubricated their life would be prolonged and the cost of maintenance lessened.

The design should be such that replacement of wearing parts are accessible. Special threads on screws should not be used except in rare cases, nor should adjustments have to be made with special wrenches or other special tools.

In laying out a new design it is well to keep in mind whether the apparatus is to be made to sell to the public or whether it is for production use. If it is for production use it should be rugged and sturdy, at the same time keeping in mind accuracy and simplicity. Round all corners where possible, avoid pockets and places hard to clean. Sink all screw and bolt heads beneath the surface and have the machine as free from protruding parts as possible so that the operator will not tear or catch clothing on them.

Welded Design

Recent developments in welded construction have been of great assistance to the designer; arc welding on the heavier types of machines, and spot welding on the lighter sheet-metal devices. In designing for welded construction do not try to duplicate the former conventional design of construction. Consider appearance at the start only as it affects the type of steel members to be used, such as formed plate or structural steel shapes. Minimize the amount of welding required by specifying bent plate and pressed steel parts wherever possible. Build the under frame of structural members and cover it over with a welded skin of sheet metal. It is surprising the pleasing appearance that can be obtained from this type of design. The design should facilitate welding by providing easy access to joints.

On the smaller devices resistance spot welding is now being extensively used on new designs. In the postwar world sheet aluminum will be more widely used than ever before and technique has been developed for satisfactorily spot welding this metal.

Plastic Design

Another recent development is in the plastics industry which in itself creates a big field for the postwar designer. Equally important is the die-casting industry. The designer must choose between these two materials in his specifications by their respective characteristics. If the design must withstand heat over 150 to 300 deg. F., practically all types of molded plastics are ruled out because of the distortion which invariably takes place. If any final machining is to be done a die casting is preferable, other things being equal.

In the design of plastic parts there are certain simple fundamental principles to keep in mind. First of all, the piece must be easily removed from the mold. Deep undercuts, re-entrant curves, or side holes can only be obtained with expensive split molds or retractable pins.

Abrupt changes in wall thickness should be avoided, and when a difference is necessary it should be held to a minimum.

Increasing the section does not increase the strength proportionately. However, it is false economy to make the walls too thin, since they are then easily broken. Do not specify narrow grooves.

When flat shapes are to be specified it is best when possible to curve the surface to some extent both ways, thus increasing the strength of the piece.

The monotony of large flat surfaces may be broken up with a pleasing effect by ribbing or fluting, or by curving or doming the surface to concentrate the high lights.

Sharp, square corners and edges should be avoided. Not only do they increase the cost, but the molded piece is subject to chipping. A full rounded edge and inside fillets should be used wherever possible. It is always preferable to have the parting line on an edge rather than on a rounded surface. This simplifies the molded part and reduces the finishing cost.

When bosses are desirable on the inside of a housing, they should be placed at the inside corners, rather than in the middle.

Long thin protuberances from the body of the molding should be avoided since they are easily broken and difficult to mold.

Inserts are readily molded securely in place, but a hill of material thick enough should be molded around them to prevent cracking due to the difference in coefficient of expansion between the metal and the plastic.

Holes are easier to mold if they go all the way through a molded piece. Holes not going all the way through should be limited to a depth of twice the diameter.

Increased desire for color is largely responsible for advances in plastics, particularly where consumer goods are involved.

Die-Casting Design

The design of die castings are subject to practically the same fundamental principles as have just been enumerated for plastic molded parts.

Die castings possess considerably greater strength than molded plastics and can be held to smaller tolerances. They can also be machined with much more safety and are not subject to as much distortion when removed from the mold as are plastic casts.

Standardization

A standards design section is one that should not be neglected, especially in the larger industrial plants. Experience with certain parts and mechanisms or subassemblies over a period of time which have proved to be of sound engineering design can be used as a basis for standards to be set up and used. They should range in size to cover all known and anticipated uses and should be flexible enough to allow for additions as warranted. When these standards are established they should be strictly adhered to except for a very good reason or an unusual condition.

The items to be standardized should preferably include knobs, handles, dovetail slides, rack and pinion units, cam rollers, bearings, spacing collars, studs, shoulder screws, index tabs and pointers, springs, hinges, and the like. The foregoing list includes only those parts common to most industries. Each particular industry has in addition to the foregoing list a special line of parts particularly adapted to their line which can also be standardized.

Appearance

If the device or apparatus is to be sold and used by the consuming public, streamlining should be resorted to if practical. Best design practice has shown that mathematical regularity creates monotony. If we are dealing with a series of squares or circles, one within the other, we find that even spacing of the elements is less interesting than progressive spacing. The progressive spacing gives a dynamic effect whereas the geometric spacing gives a static effect.

The number of designers and manufacturers is small who appreciate sufficiently the opportunities which colors afford in the designs of new devices in building markets and prestige.

Right colors in right places are not only appealing but practical when applied to certain types of machinery. Some designers take advantage of the relatively inexpensive expedient of using correct colors to secure a degree of improvement in appearance that was formerly held possible only by costly pattern and die changes for the new models. It is not contended that factors such as mechanical precision and the engineering merit of a machine can be overlooked simply by correctly streamlining and coloring various parts in relation to each other. It is maintained, however, that the use of color and streamline effect can produce appeal which increases sales volume.

THE INDUSTRIAL ARTS AND COMPETENT ADULTHOOD

A careful examination of the objectives of general education and of those in the industrial arts suggests that there is no conflict in the ideals set forth, and that legitimate and desirable objectives for general education are also legitimate and desirable for the industrial arts. As a part of the general-education program it is the special function of the industrial arts to provide experiences which will develop certain traits, habits, and points of view which have been neglected altogether or merely touched upon in the other subjects. — *M. L. Byrn,* University of Michigan School of Education Bulletin, May, 1944.

The barrels of our Army Air Force rocket guns — the flying bazooka — are made of paper treated with heat-resistant plastics. — *American Forest Products Industries, Inc.*

Industrial Arts and Vocational Education

John J. Metz, Editor

This Problem of Testing

The present issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION is the annual testing number. The February number has been specially set aside to reiterate how important testing is for those who are teaching or supervising in the fields of industrial arts and vocational education.

It is unfortunate that many of those engaged in doing such outstanding work in training our youth in the practical fields of education do not realize the necessity of obtaining some sort of measure whereby they can evaluate their own and their students' accomplishment. Some instructors still maintain that they can gauge their students' accomplishment merely by reviewing mentally what a particular student has done during a given period of time in the school shop. They seem to forget entirely that many factors enter into arriving at such a subjective value, and that the result which they arrive at is by no means as valid as they seem to think.

During the year 1944, INDUSTRIAL ARTS AND VOCATIONAL EDUCATION has provided its readers with a number of articles on tests and testing and similar articles will again appear during the present year.

Readers may not like or approve of all that the writers have put into these articles and tests. That is not really what was aimed at in publishing this material. The big (you might say the sixty-four dollar) question is, are you using a testing program of your own? If so, is your testing procedure better than those proposed in the published articles? Again, if so, then do your fellow workers a good deed by giving them an opportunity to share with you the results of your successful work. If, on the other hand, you have not as yet tried out a real testing program, then try out some of the tests that have been presented, and become acquainted with the value which objective testing will instill into your teaching program.

Your Pet Project

Almost every shop teacher has a pet project which he prizes above the other things produced in his classes. Some of these pets are really worth while and they deserve to be passed along. The past few years with its shortages and rationing of all sorts of materials have been especially hard on the shop teachers, some of whom were severely handicapped, while others seemed to go along without experiencing any great trouble.

A good stock of prewar materials helped some to surmount their troubles. Others were able to make advantageous contacts with near-by manufacturing firms, who furnished them with usable scrap. In this way they were able to weather the shortages. Still others started to use mediums which they had never thought of trying in their shops before. Then there were those who had their students bring repair jobs and the wherewithal to make the repairs from the home, thus solving the material problem and the project problem at one and the same time.

No matter how you solved your teaching problem, it may help a fellow teacher if you tell him what you did to solve yours.

No matter, then, what material your pet project was made of, a good description of it with suitable working drawings may well be worth publishing in your professional journal. In this way you will be assisting those who need the help of others, and at the same time you will be strengthening the cooperative tie which ought to embrace all engaged in the task of preparing our youth for their life's work.

The Impact of War on Educational Institutions

Industrial research in American universities is nothing new. Nevertheless, the war has given a really astounding impetus to this phase of educational work.

Dr. A. R. Olpin, head of the Ohio State University Research Foundation, states that within the past year approximately sixty universities have inquired from him how to get an industrial research department organized. The need for educational institutions going into these activities was brought about by the many requests that came from industry for aid. Before the war about one hundred universities offered industrial research. This number may be doubled by the time the war ends, and the work that is turned out by these research departments has already been increased a great deal.

Industry has discovered how much education has been able to help during the mad rush for equipping our country to enter the world conflict. It is placing much more dependence on the school than it did in the past. Of course, those of us interested in industrial arts and vocational education may not be able to offer much research work to industry.

But we may, and do, look with considerable pride on the fact that vocational education stepped into the breach when hundreds of thousands of workers had to be trained to do work that they had never done before. Not only did the schools take over the problem to train these workers, but they undertook to do the work practically overnight. Then when the school day became too short to perform the work that was required, morning and night shifts were started so that the school soon resembled an industrial plant running the clock round.

In the postwar era, the school is confronted by much the same type of problems. There is so much to be done. The workers who have been trained to do a narrow specialized job may want to come back for more training so that they may qualify as all-round mechanics. Many of the returning servicemen will want vocational training. And then there are thousands of young students who choose to enter our vocational classes to prepare themselves for entry into the industrial world.

Although the majority of them may not become skilled all-round craftsmen, yet many of them will occupy positions such as maintenance men, servicemen, or repairmen. They, therefore, will require a good grounding in technical subjects as well as training which imparts to them some of the skills needed by the all-round mechanic.

The training given for war production has produced many workers who are skillful and resourceful enough to quickly qualify for positions as servicemen, installation men, and maintenance men. But they do need to know more about the technical side of some of the products on which they are to work.

To furnish this type of knowledge is one of the problems of vocational education, and it may well be one of the phases of postwar vocational education planning to prepare courses and texts for this type of technical training. It is true, the war-production training program was started by the vocational schools without much time for preparation, but most of the work required fell into some of the older courses that had been previously taught in these schools. Even then, many textbooks had to be prepared for some of the newer phases of the work.

Knowing then what is in the offing it is time to think about this problem.

To mention only one or two cases of a need that will have to be fulfilled — there will have to be training materials for repairmen and maintenance men for refrigeration installations, also for air conditioning, and similar household, store, and office equipment and accessories. Much of this work is of a light nature and may well be considered suitable for some of our returning servicemen.

Teachers who know something about these and similar subjects ought to think seriously about producing analyses, outlines of instruction, instructional and illustrative material, and textbooks that may be used in day and evening classes for training this type of help. The need is there; vocational education knows how to solve problems of this type; there is but one thing to do, and that is to follow the suggestion contained in the brief American expression — "get busy."

Testing and Tests

CONSTRUCTING ACHIEVEMENT TESTS

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It is widely recognized by teachers and administrators in vocational education work that the lack of suitable devices for testing student achievement presents a serious weakness. Three major reasons for the existence of this weakness are: (1) the failure of many instructors to see the real uses and advantages of objective tests, (2) the difficulties of instructors in developing course materials into practical test situations, and (3) the lack of time needed in building suitable test items. This article has been written to aid instructors in vocational subjects to construct better objective tests, and to use these tests to the best possible advantage.

The Advantages of a Testing Program

It is useful first of all to consider what advantages a well-organized testing program can offer. From the viewpoint of the instructor, a properly constructed series of tests could be of considerable value in improving instruction. Tests of the types to be described here must of necessity measure knowledge or skills of a specific rather than a general nature. Thus the instructor who prepares such tests for use by his students is constantly encouraged because of the tests to direct his teaching in terms of the course objectives, and to express these objectives in specific rather than in general terms. If the tests for a particular course are constructed, as they should be, to measure the objectives in which progress is expected, then the instructor will have those objectives in mind as he teaches. Another important advantage to the instructor is that test results can help him to discover the weak spots in his teaching. If a substantial percentage of the students — good and poor alike — have difficulty in answering questions on certain parts of the course material, then the instructor might well analyze his teaching methods or the course content to determine the causes for this failure.

The obvious use of tests is to provide a grade for the student. If tests are built so that they provide separate scores based on competence in each of the major divisions of the course, tests can provide far more than a mere ranking of students by single letter or numerical grades. By this part-score plan, test results can be made to indicate the areas in which a student is weak or strong — important data which is not usually brought out by the traditional grading plans. For example, where a numerical grading system is used, it is quite likely that two students receiving a grade of 70 may be qualified in different areas of the course work. If the test results were reported in terms of course objectives, it could then be stated that one student possessed certain knowledges or skills, whereas the other student had what were perhaps different abilities. The statement of student accomplishment in positive terms such as these can make possible aid to students on the basis of their individual needs. From the student's viewpoint, such a system makes it possible for him to know how he is progressing in terms of the job to be accomplished.

Analyzing Course Objectives

The first step in the construction of achievement tests should be a careful analysis of the course objectives. Obviously it is not practicable to attempt to build a test until it is clearly understood what the course is planned to do. Assume for example that an instructor is teaching an elementary course in direct current electricity. Several objectives which students might be expected to achieve in this course are: (1) the ability to recall important specific facts, (2) a knowledge of the terminology essential to an understanding of direct current electricity, (3) the ability to interpret simple data such as graphs and tables, (4) the ability to apply the principles governing voltage, current, and resistance, and (5) the ability to use electrical measurement instruments and laboratory equipment. This procedure for determining course objectives before constructing the test has a number of valuable uses: (1) it indicates to the instructor the material to be taught in the course, (2) it is an aid in planning the presentation of the subject matter for classroom, workshop, or laboratory teaching, and may suggest new ways in which the material can be taught, (3) it is helpful in determining if and when the objectives of the course have been successfully achieved, (4) it is a criterion for the inclusion or omission of various items from the tests, and (5) it enables the instructor to examine the items he prepares for his tests in the light of his own standards rather than those set up by others.

Before proceeding any further in the development of a test, the instructor should have clearly in mind what he means by each of the objectives he has stated for the course. For example, if one of the objectives is knowledge of terminology, it must be decided whether the student is expected to be able to define various terms, to recognize their correct use in a sentence, or to recognize the statement of the correct definition of the terms. If another objective is a knowledge of certain general principles, the question again arises as to what the student is expected to know about these principles. The course may have stressed recognition of these principles, it may have emphasized the application of the principles in real situations, or it may merely have featured knowing what principles apply in particular situations. It is especially important to see clearly what the real objective is in each case, since acquisition of knowledge and the skill needed in applying that knowledge are usually tested by different techniques.

Collecting Material for a Test

Once the course objectives have been stated clearly, a list should be made of the specific points of information and statements of skills the student should acquire in the course. If it is found that there is more material to be tested than can readily be handled, the instructor can go over the material to determine which of it is essential in providing a satisfactory understanding of the course.

A question next to be decided is how the test being made is to be used. It may be that the test is to be used merely to determine the relative performance of the students. On the other hand, as mentioned previously, the test may be designed to find out the weak and strong points in the performance of individual students. A third purpose of a test may be to check the effectiveness of teaching by analyzing the right and wrong answers students make in responding to each of the test items. A count can be made of the percentage of students who answer each item correctly, and the wrong responses also can be tabulated. Thus the instructor can accurately determine what points the students are learning, and what ones they are not. At the same time it is possible to make improvements in the test for future use in the light of the students' responses to the various items.

Selecting the Test Situations

The next step in test construction is the selection of the test forms, or test situations. It must be remembered that the final test of a student's competence in vocational subjects is his success on the job itself. Classroom testing is resorted to only because of the difficulty of simulating actual job conditions. The question of what type of test situation to use can be answered by deciding upon the ways in which students can reveal their knowledge

of the objectives being measured. There is no need to rely upon pencil and paper tests if various types of performance tests can be used in measuring the desired competence. Several illustrations can show the wide range of test situations which can be used.

Referring again to the course in elementary electricity, the following are examples of test situations which might be used to measure the student's attainment of the first four of the objectives previously mentioned. These are: (1) the ability to recall important specific facts, (2) a knowledge of the terminology essential to an understanding of direct current electricity, (3) the ability to interpret simple data such as tables and graphs, and (4) the ability to apply the principles governing voltage, current, and resistance.

Ability to Recall Important Specific Facts

Directions to Student: Each of the following items consists of an incomplete statement which may be correctly completed by one or more of the phrases given below the statement. Place a check (√) in the parentheses before each phrase which will make the statement true.

1. Ohm's Law may be stated as follows:
( ) (*a*) The voltage in a d.c. circuit is equal to the current times the resistance.
( ) (*b*) The current in a d.c. circuit is equal to the voltage times the resistance.
( ) (*c*) The resistance in a d.c. circuit is equal to the voltage times the current.
( ) (*d*) The resistance in a d.c. circuit is equal to the voltage divided by the current.
( ) (*e*) The current flowing in a d.c. circuit is equal to the resistance divided by the voltage.

2. The value of the e.m.f. developed by an electric battery depends upon
( ) (*a*) The materials used for the plates.
( ) (*b*) The area and thickness of the plates.
( ) (*c*) The chemical composition of the electrolyte.
( ) (*d*) The distance between the plates.
( ) (*e*) The type of the separator employed.

3. Kirchoff's first law states that
( ) (*a*) If the currents flowing toward a point are considered positive, those flowing away should be considered negative.
( ) (*b*) The current flowing away from any point must always be equal to the current flowing into the point.
( ) (*c*) The current in any branching network of wires is equal to the voltage at that point divided by the resistance.
( ) (*d*) At any junction in an electrical circuit the algebraic sum of the currents at that point is zero.
( ) (*e*) If the currents flowing toward a point are considered negative, those flowing away should be considered negative.

It should be noted that the foregoing three examples are only illustrations of the technique and are not meant to cover an entire course. By wording the alternatives under each statement so that they sound plausible, it is possible to obtain a rather adequate measure of whether the student actually possesses the desired knowledge or whether he is guessing.

Terminology Essential to an Understanding of D.C. Electricity

Directions to Student: In the blank before each statement on the left, write the number of the term in the right-hand column which the statement defines:

Definitions or Descriptions of Terms

...The ratio of the current to the voltage
...The unit of resistance
...The conductance of a circuit
...The reciprocal of the resistance of a circuit
...The product of the current squared multiplied by the resistance
...The product of the voltage times the current
...The unit of magnetomotive force
...The specific conductivity for magnetic flux
...Unit used in measuring diameter of wires

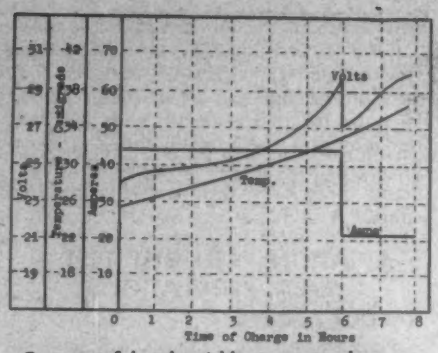
Terms	*Terms*
1. Ampere	8. Ohm
2. Circular mil	9. Permeability
3. Conductance	10. Power
4. Energy	11. Resistance
5. Gilbert	12. Volt
6. Mho	13. Voltage
7. Mil foot	14. Watt

It should be noted that this type of matching list has a greater number of terms than there are definitions. Hence the student is not able to answer the last few items by a process of elimination. This exercise is easy to correct, and requires little space. It should not be used, however, unless the terms to be tested do have similar features. Otherwise, the statements are likely to be correctly identified without more than a superficial knowledge of the material.

Ability to Interpret Data

Directions to Student: In this section of the test you are given a set of curves which were obtained from a test of a lead acid battery on charge. Study the curves and then answer the questions which follow.

1. When the battery has been charging for three hours, what is the value of the voltage? ....
2. When the temperature is 30 deg. C. what is the value of the voltage? ....
3. When the charging rate is dropped, the voltage changes from .... to .....
4. What effect does the lowering of the charging rate have on the temperature? ....
5. When the voltage is 25, what is the value of the current and the temperature? ....



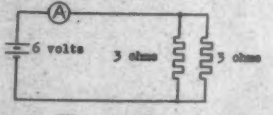
Curves of lead-acid battery on charge. Twelve cells, 250 ampere-hours, constant-current. Charge at 43 amperes tapered to 22 amperes. Constant-current method of charging batteries

Many other illustrations and questions might be utilized which would give additional indication of the student's ability to interpret graphic materials, but these few items should demonstrate the technique. In this case the student is called upon to write in the answers rather than to select one of several choices provided, but these items could readily be converted into multiple-choice exercises.

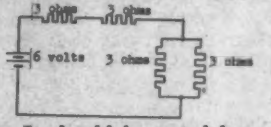
Ability to Apply Principles of Voltage, Current, and Resistance

Directions to Student: In each of the exercises which follow, you are to apply Ohm's Law and then indicate with a check mark (√) the answer which you believe to be correct.

1. The current which would flow through the ammeter *A* in this circuit would be (neglect the internal resistance of the battery):



2. The total resistance of this series-parallel circuit would be (neglect internal resistance of the battery):



It should be noted here that the arithmetical computation involved in these problems is very simple. The emphasis is placed on whether the student can apply the principles involved and not on his mathematical accuracy. By making the arithmetic relatively easy, it is possible to sample a much wider range of the student's knowledge of principles in a given time than if involved computations were required. Although arithmetical accuracy is important, it can be tested more directly by other means. In making up the alternative answers an attempt is made to use those which are plausible and which would sound reasonable to a student not

well versed in the fundamental principles.

Good tests cannot be constructed quickly, nor can they be considered as mere afterthoughts in an instructor's work. If tests are built scientifically, however, the results of their use in terms of benefits to instructor and student will repay many times over their cost in time and effort.

AVIATION PREFLIGHT TEST — C.A.A. REGULATIONS

HAROLD T. GLENN

David Starr Jordan High School
Long Beach, Calif.

Directions: Complete each statement correctly by supplying the missing word or words, phrase, or numbers.

1. Aircraft approaching for a landing must make a ..... circle and keep on a straight course for the last ..... feet.
2. Aircraft must not be flown closer than ..... feet vertically nor closer than ..... feet horizontally to a cloud formation.
3. An aircraft which is landing (has or has not) ..... the right of way over the one which is taking off.
4. You (have or have not) ..... the right of way over a plane which is approaching you from your left.
5. In passing another slower plane you must pass to the ..... side of it.
6. When two planes approach each other head on, ... gives way and passes to the ..... of the other.
7. Private planes may not fly over ..... altitude.
8. Aircraft may not fly closer than ..... feet to any other aircraft.
9. Acrobatics over congested areas (are or are not) ..... permitted. Elsewhere acrobatics are allowed only at an elevation of ..... feet.
10. Navigation lights for night flying should be: right wing ..... light, left wing ..... light, rear taillight .....
11. Aircraft in flight have the right of way in the rotation shown. Place the numbers 1-2-3-4 correctly in the parenthesis in the proper order: ( ) gliders, ( ) balloons, ( ) planes, ( ) airships.
12. A teletype weather report of *C* means ..... flight; *N* means ..... flight; *X* means .....
13. The minimum altitude allowed over cities is ..... feet; over open fields .....; on instrument flight ..... feet.

If a statement in the following group is true, encircle the *T*. If it is false, encircle the *F*.

T F 14. A licensed pilot may fly any plane.
T F 15. A private pilot may not give instruction without an instructor's license.
T F 16. A commercial pilot may give instructions without an instructor's license.
T F 17. A student pilot may not make a flight outside of the airport area.
T F 18. A private pilot may not operate a plane or carry people for hire.
T F 19. Flashing the navigation lights in a series of short flashes means turn on the landing field lights.
T F 20. A pilot must record every flight in a log book.
T F 21. Parachutes must be repacked every 60 days.
T F 22. A clearance report must be obtained before every takeoff.
T F 23. Planes on contact flight crossing the civil airways must increase their altitude 500 feet.
T F 24. Planes without radio must not use the civil airways over 3500 feet.
T F 25. A pilot, before he stunts over a city, must be sure that his passengers have a parachute, and are secured with their safety belts.

KEY

1. left; 1000	13. 1000; 500; 1000
2. 500; 2000	14. F
3. has	15. T
4. have	16. F
5. right	17. T
6. each; right	18. T
7. 17,000	19. F
8. 500	20. T
9. are not; 15,000	21. T
10. green; red; white	22. T
11. 2, 1, 4, 3	23. T
12. contact; instrument; no flying	24. T
	25. F

EVERY PUPIL SCHOLARSHIP TEST

ROBERT P. JENSEN

On leave from Kansas State Teachers College
Emporia, Kans.
Now Teaching Co-ordinator with
Pratt & Whitney Aircraft Corporation of Missouri

Directions: Read the directions for each part and follow them. Answer easy items first; return to others later. You will have exactly 40 minutes.

Part I

Directions: Read the following sentences carefully. If a statement is true, place a plus (+) in the parenthesis before the statement, as in example A below. If the statement is false, make a minus (—) in the parenthesis, as in example B.

Examples: (+) *a*) America was discovered by Columbus.
(—) *b*) The first president of the United States was Lincoln.

( ) 1. The junior jack plane is 11 in. in length.
( ) 2. The tongue of a steel square is longer than the blade.
( ) 3. The heel of a saw is near the handle.
( ) 4. An orthographic drawing is the type used to give the workman information needed to make a project.
( ) 5. A saw should have more set for softwood than for hardwood.
( ) 6. Lines and symbols are used as the language of the draftsman.
( ) 7. Pumice stone may be ground to form a polishing material.
( ) 8. Tin cans contain more tin than iron.
( ) 9. To saw wood accurately the center of the saw cut should be directly over the mark indicating the length or width of the piece to be sawed.
( ) 10. Dry woods require more set in the saw than green woods do.
( ) 11. Iron is frequently found in chunks of pure metal.
( ) 12. When iron ore is melted limestone is also put into the furnace.
( ) 13. Bell wire is No. 18 wire.
( ) 14. Home lighting circuits are run on 100 volts.
( ) 15. The Underwriter's knot is used in wiring a drop cord.
( ) 16. Compared to other metals and alloys, nichrome is a poor conductor of electricity.
( ) 17. A marking gauge with a sharp steel point should be used to lay out chamfers.
( ) 18. A plane like a junior jack plane but 14 in. in length would be classed as a jointer plane.
( ) 19. When three views of an object must be shown the top view is placed above the end view.
( ) 20. For general work the plane iron cap should be set back 1/16 in. from the cutting edge.
( ) 21. Push down on the handle at the start of the plane stroke and on the knob at the finish of the stroke.
( ) 22. The plane will plane end grain better if the blade is not set so deeply as when planing edge grain.
( ) 23. The cutting angle of the plane iron is from 25 to 30 deg.
( ) 24. A single center line is used in a drawing to locate the center of a circle.
( ) 25. The filament of modern lamp bulbs is made of carbon.
( ) 26. The generator changes mechanical energy to electrical energy.
( ) 27. There is a magnetic field around any wire through which a current flows.
( ) 28. A thirty ampere fuse is used in home lighting circuits.
( ) 29. A magnet will attract nickel silver.
( ) 30. Papyrus was the first form of paper.
( ) 31. Bond paper is used for business stationery.
( ) 32. Headbands on a book serve as borders on the title page.
( ) 33. The regulation book section contains 16 pages.
( ) 34. Dimension and extension lines are the same in weight.
( ) 35. A reference line points to a special part and leads from specifications for that part.
( ) 36. A good scale for architectural drawings of a house would be one fourth inch equals one foot.
( ) 37. Construction lines should be made light enough so that they may be easily erased.
( ) 38. If an error has been made it is best to erase drawing ink immediately before the ink gets dry.
( ) 39. The upper edge of the T square should be used as a guide in drawing vertical lines.
( ) 40. When there is a choice of position, dimension lines should be placed at the right or at the bottom of the views.
( ) 41. Filing metal in a vise would be an operation in a metal unit called bench metalwork.
( ) 42. A hack saw with 18 teeth to the inch would be regarded as a fine tooth saw in metalwork.
( ) 43. The Bessemer converter is used to change wood pulp to paper.
( ) 44. Tool steel contains more carbon than mild steel.
( ) 45. If a chisel gets dark colored from heat while it is being ground the steel has been softened.
( ) 46. If a board is to be chamfered the end should be chamfered first to prevent splitting at the corners.

( ) 47. The T bevel is a type of square with a movable blade.
( ) 48. Round shank twist drills are held in a tool called a bit stock.
( ) 49. The special file for filing auger bits is like a double end canoe paddle in shape.
( ) 50. Straight shank twist drills are used in a hand drill.
( ) 51. The head of the casing nail is the same shape as the head of the finishing nail.
( ) 52. A compass saw and a keyhole saw are the same shape.
( ) 53. The hand scraper is clamped in a special handle called a cabinet scraper.
( ) 54. The standard size of sandpaper is a 9 by 11-in. sheet.
( ) 55. The tenon is usually cut one half the thickness of the stock being joined.
( ) 56. Dowel rods are made of soft white wood.
( ) 57. The numeral 8 in mechanical drawing is formed by drawing two ellipses one slightly larger than the other.
( ) 58. Small size capitals are referred to as lower case letters.
( ) 59. The architects scale is divided into fractions and the engineer's scale into decimals.
( ) 60. A double cut file is so named because it cuts on the pull and push stroke.
( ) 61. A bastard cut file is a coarse file.
( ) 62. High speed steel is another name for high carbon steel.
( ) 63. Round shank twist drills for woodwork have the same lettering system as auger bits to denote size.
( ) 64. A diestock holds the cutting tool when cutting outside threads.
( ) 65. Rotten stone is a polishing material used in wood finishing.
( ) 66. C clamps for woodwork are made of hard maple.
( ) 67. The common type of hinge with both sides equal in width is called a butt hinge.
( ) 68. Spirit stains are used in refinishing work.
( ) 69. An oil stain is more transparent than a water stain in woodwork.
( ) 70. Birch wood requires a paste wood filler in finishing.
( ) 71. Shellac dries more rapidly than varnish.
( ) 72. Spraying lacquer dries more rapidly than shellac.
( ) 73. Plain-sawed lumber will not warp as easily as quarter-sawed lumber.
( ) 74. Rip saw teeth are like two parallel rows of small chisels.
( ) 75. The length of a round head screw is measured from the point to the top of the head.
( ) 76. Animal glue should be heated to 180 deg. F., when being used.
( ) 77. Flake animal glue should be soaked in cold water before it is heated.
( ) 78. Flint sandpaper cuts better and lasts longer than garnet sandpaper.
( ) 79. In the lumbering industry workers called swampers trim the branches from the fallen tree.

Part II

Directions: Place the number of the part which makes the best answer to the statement in the parenthesis before the sentence, as in the example.

Example: (3) The capital of the United States is: (1) Boston, (2) Chicago, (3) Washington, (4) New York.

In this example "Washington" is the correct answer; therefore, a figure "3" has been placed in the parenthesis.

( ) 80. The best of the following woods for shingles is: (1) ash, (2) oak, (3) pine, (4) cedar, (5) elm.
( ) 81. The name of the tool used to thread a rod is: (1) tap, (2) die, (3) socket, (4) reamer, (5) threader.
( ) 82. Tool steel would be made with which of the following carbon contents? (1) 2, (2) 3, (3) 1.2, (4) 5.
( ) 83. Which of the following woods is most durable when exposed to the weather? (1) maple, (2) cherry, (3) oak, (4) poplar, (5) basswood.
( ) 84. The shape of the file used to sharpen the handsaw is: (1) half round, (2) square, (3) flat, (4) triangular.
( ) 85. The name of the tool used to clean the file is: (1) file cleaner, (2) file card, (3) bench brush, (4) metal cleaner.
( ) 86. What type of shank must a twist drill have if it is used in a bit brace? (1) triangular, (2) square, (3) round, (4) taper.
( ) 87. What polishing material is used in coating cloth for polishing metal? (1) flint, (2) garnet, (3) emery, (4) granite.
( ) 88. The chisel used to cut metal is called: (1) metal chisel, (2) shearing chisel, (3) cold chisel, (4) iron chisel.
( ) 89. The chief iron ore region in the United States is in: (1) New York, (2) Alabama, (3) Minnesota, (4) California, (5) Ohio.
( ) 90. The machine used to make straight bends for sheet-metal seams is the: (1) bar folder, (2) squaring shear, (3) metal bender, (4) hand seamer.
( ) 91. The voltage of four common dry cells connected in series is: (1) 4, (2) 6, (3) 10, (4) 20.
( ) 92. Twelve 50-watt lamps burned five hours use how many kilowatt hours of power? (1) 60, (2) 3, (3) 12, (4) 50, (5) 5.
( ) 93. How many board feet are there in a board 2 by 10 in. by 6 ft.? (1) 12, (2) 120, (3) 10, (4) 2, (5) 6.
( ) 94. How many board feet of lumber in a board ½ by 12 in. by 12 ft.? (1) 12, (2) 6, (3) 24, (4) 144.
( ) 95. How many board feet of lumber in a board 1 by 6 in. by 60 in.? (1) 60, (2) 2.5, (3) 36, (4) 30, (5) 3.

Part III

Directions: From the list of answers in Column II select the word which matches each item of Column I and write the number of the answer in the parenthesis at the left of the item. Answers in Column II may be used more than once.

Column I

( ) 96. The number of inches represented by (3′ + 9″).
( ) 97. The number of sixteenths in (2¼″).
( ) 98. The number of sixty-fourths (⅛″).
( ) 99. Designating a soft drawing pencil.
( ) 100. The term describing the enlargement or reduction of a drawing.
( ) 101. The sum of the three angles of a 30–60 triangle.
( ) 102. The instrument used to step off spaces.
( ) 103. The number of teeth per inch for a hacksaw blade to be used on sheet metal.
( ) 104. The part of the drill press used to clamp the bit.
( ) 105. The voltage of the commercial dry cell.
( ) 106. The voltage of a car battery.
( ) 107. The measure of the unit of resistance in electricity.
( ) 108. A device used to change the voltage of a.c. current.
( ) 109. A material used to cover pitchy places and knots before painting.
( ) 110. A material used in upholstering.
( ) 111. A term denoting that both edges and both faces of a piece of lumber are to be finished.
( ) 112. The groove or saw cut.
( ) 113. A saw cut not at right angles but at an angle extending through the board.
( ) 114. The number on a ⅜-inch auger bit.
( ) 115. A type of nail thinner than the common nail.
( ) 116. A half-round bevel edged chisel.
( ) 117. That part of the board where the edge and face meet.
( ) 118. A groove cut across the grain of a board.
( ) 119. That part of a joint into which the tenon fits.
( ) 120. A clamp used in gluing.

Column II

1. AB	10. dividers	18. scale	26. 6
2. arris	11. FAS	19. shellac	27. 8
3. bevel	12. glue	20. trans-	28. 12
4. box	13. gouge	former	29. 32
5. brace	14. hand	21. vise	30. 36
6. chamfer	screw	22. volt	31. 40
7. chuck	15. kerf	23. webbing	32. 45
8. compass	16. mortise	24. 1.5	33. 110
9. dado	17. ohm	25. 4B	34. 180

KEY				
Part I	15. (+)	31. (+)	47. (+)	63. (—)
1. (+)	16. (+)	32. (—)	48. (—)	64. (+)
2. (—)	17. (—)	33. (+)	49. (+)	65. (+)
3. (+)	18. (—)	34. (+)	50. (+)	66. (—)
4. (+)	19. (—)	35. (+)	51. (—)	67. (+)
5. (+)	20. (+)	36. (+)	52. (+)	68. (+)
6. (+)	21. (—)	37. (+)	53. (—)	69. (—)
7. (+)	22. (+)	38. (—)	54. (+)	70. (—)
8. (—)	23. (+)	39. (—)	55. (+)	71. (+)
9. (—)	24. (—)	40. (+)	56. (—)	72. (+)
10. (—)	25. (—)	41. (+)	57. (+)	73. (—)
11. (—)	26. (+)	42. (—)	58. (—)	74. (+)
12. (+)	27. (+)	43. (—)	59. (+)	75. (—)
13. (+)	28. (—)	44. (+)	60. (—)	76. (—)
14. (—)	29. (—)	45. (+)	61. (+)	77. (+)
	30. (+)	46. (—)	62. (—)	78. (—)

79. (+)	87. (3)	**Part III**	104. (7)	113. (3)
Part II	88. (3)	96. (32)	105. (24)	114. (26)
80. (4)	89. (3)	97. (30)	106. (26)	115. (4)
81. (2)	90. (1)	98. (27)	107. (17)	116. (13)
82. (3)	91. (4)	99. (25)	108. (20)	117. (2)
83. (3)	92. (2)	100. (18)	109. (19)	118. (9)
84. (4)	93. (3)	101. (34)	110. (23)	119. (16)
85. (2)	94. (1)	102. (10)	111. (11)	120. (14)
86. (2)	95. (2)	103. (29)	112. (15)	

MACHINE-SHOP TEST

FRED DECKER

Detroit, Mich.

General Directions: This test will take approximately forty minutes. Read the directions for each part carefully. It will not be necessary to ask questions.

Part I

Yes-No. (1–25) (25 points). Several questions follow, some of which should be answered by yes and others by no. If the answer is yes, draw a circle around the capital letter Y at the left, and if no, circle the capital letter N. Your score will be the number right minus the number wrong.

Example: (Y) N A file should be kept clean.

1. Y N Is mechanical drawing a universal language?
2. Y N Does a working drawing represent objects by views?
3. Y N Are working drawings used by the home builder, home-owner, engineer, lawyer, doctor, and skilled mechanic?
4. Y N Will you learn to read a blueprint in ordering material to do a job in the machine shop?
5. Y N Is a job a problem that requires solution?
6. Y N Is the combination square a common tool?
7. Y N Did the motor industry create the need for standardization of interchangeable parts?
8. Y N Is it good practice to have the tool rest of the grinder an inch from the grinding wheel?
9. Y N Do you use oil on an oilstone to keep the stone from wearing out?
10. Y N Is a boring tool used to enlarge a drilled hole?
11. Y N Can you set an outside caliper to a steel rule?
12. Y N Does too much front clearance on a tool bit tend to strengthen the cutting edge?
13. Y N Is a ⅜-in. tap drill 5/16 in. in diameter?
14. Y N Will the adjustable hand hack-saw frame take blades 6 to 12 in. in length?
15. Y N Would you use the flat bastard file for draw filing?
16. Y N Is the micrometer caliper used for very accurate measurements?
17. Y N Would you consider it necessary to wear goggles at the shaper?
18. Y N Should chips be removed from the drill press with the fingers?
19. Y N Would you decrease the pressure as the drill is breaking through the metal while drilling a job at the drill press?
20. Y N Would you use a rag for cleaning the milling machine while the machine is in motion?
21. Y N Would you shift gears on a lathe while the machine was running at slow speed?
22. Y N Are taper shank drills used for drilling the larger holes?
23. Y N Would you grind the right-hand side tool at 60 deg.?
24. Y N Can you use the compound rest for turning a taper?
25. Y N Is feed the amount the tool travels or advances in each revolution of the work?

Part II

True-False. (26–50) (25 points). Read each item below and decide whether it is true or false. If the item is true, draw a circle around the capital letter T at the left, if the item is false circle the F. Your score will be the number right minus the number wrong.

Example: (T) F The machinist hammer has a wooden handle.

26. T F The power hack-saw blade does not lift on the return stroke.
27. T F Hand hack-saw blades are measured from the center of one hole to the center of the next when the blade is under 14 inches.
28. T F Some manufacturers harden the hand hack-saw teeth only, leaving the blade flexible.
29. T F The file used most for lathe work is the mill file.
30. T F For boring of tapers the tool should be a little below center.
31. T F Taper per foot is never given on a drawing.
32. T F No. 3 emery cloth is very coarse.
33. T F An alloy is a mixture of two or more metals.
34. T F A three-jaw universal chuck takes small stock.
35. T F A thread micrometer measures pitch diameter of threads.
36. T F A standard taper ring gauge is used to test external tapers.
37. T F A hand reamer may be used after the drilled hole has been bored to within .005 of the finished size.
38. T F A machine reamer may be used after the hole has been drilled to within 1/64 in. of the finished size.
39. T F Taper is the difference in diameter for a unit of length of a conical piece of work.
40. T F For the turning and boring of tapers, the cutting edge of the tool should be set exactly at the center of the work.
41. T F There are four methods of turning and boring tapers.
42. T F The compound rest of the lathe is graduated in degrees.
43. T F A milling machine arbor is used to hold work for further machining.
44. T F A mandrel is used to hold work while it is being further machined.
45. T F Use rapid indexing on dividing head while milling a hexagon.
46. T F Indexing is the process of dividing the circumference of a piece into equal parts.
47. T F The radius of a circle is any straight line drawn from the center to the circumference.
48. T F High speed tool steel is a high grade tool steel.
49. T F The locomotive made the lathe possible.
50. T F Accuracy is one of the characteristics of a good machinist.

Part III

Multiple-choice (51–75) (25 points). In each item below, underline the correct answer and write its number in the parenthesis at the left. Your score will be the number of right answers.

Example: (1) A machinist's hammer has a (1) *wood,* (2) metal, (3) leather handle.

51. ( ) The amount of taper is determined (1) on one half the length of the work, (2) the entire length of the piece, (3) on one fourth the length of the piece, (4) on the tapered part only.
52. ( ) The (1) Morse standard taper, (2) Browne and Sharpe, (3) American, (4) Sellers taper is used chiefly on headstock and tailstock spindles of lathes.
53. ( ) For accuracy in taper turning, the taper should be tested (1) before taking a cut, (2) after taking a cut, (3) anytime, (4) when completed, (5) just before taking a cut.
54. ( ) A boring tool has a tendency to spring (1) up, (2) down, (3) toward the top, (4) not to spring at all.
55. ( ) There are (1) two, (2) four, (3) three, (4) five methods of taper turning in a lathe.
56. ( ) For turning and boring tapers, the tool should be set (1) exactly at the center of the work, (2) below, (3) above, (4) near the center of the work being tapered, (5) 5 degrees above center.
57. ( ) Turning or boring a taper by use of the compound rest is one of the (1) two, (2) four, (3) three, (4) six methods of taper turning and boring.
58. ( ) Reamers should be turned (1) clockwise, (2) counterclockwise, (3) to the left, (4) up, (5) out.
59. ( ) Hand reamers may be started easily by "spotting" a hole to the depth of ⅛ in. with a drill (1) the same size of the reamer, (2) smaller, (3) larger, (4) any size.
60. ( ) There are (1) one, (2) two, (3) four, (4) three, (5) five grades of knurling.
61. ( ) When stepping up to a shaper, one should (1) turn the hand wheel to see that everything clears and that the length and position of the stroke is correct, (2) engage the automatic feed, (3) release the clutch, (4) turn on the power.
62. ( ) When the drill is breaking through the stock, one should (1) increase the pressure, (2) decrease the pressure, (3) release all the pressure, (4) give the drill a jerk.
63. ( ) A drill chuck should be removed from the drill press spindle with (1) drift, (2) file, (3) hammer, (4) chuck key.
64. ( ) While working at the lathe, one must keep his sleeves rolled up because (1) it keeps them clean, (2) it looks better, (3) it is unsafe to work with long sleeves, (4) the teacher demands it.
65. ( ) The power hack-saw blade may be (1) 6 in., (2) 8 in., (3) 10 in., (4) 14 in. long.
66. ( ) Steel surfaces which are to be laid out should be coated with (1) purple layout dye, (2) chalk, (3) vermilion, (4) white lead.
67. ( ) The hand hack-saw blade should be operated at (1) 20, (2) 30, (3) 50, (4) 40, (5) 80 strokes per minute.
68. ( ) The beveled edge of the thimble on the micrometer caliper is divided into (1) 25, (2) 20, (3) 15, (4) 10, (5) 5 equal parts.

69. ( ) The center drill is always ground at (1) 40 degrees, (2) 50 degrees, (3) 60 degrees, (4) 30 degrees, (5) 29 degrees.
70. ( ) An independent lathe chuck has (1) three, (2) two, (3) four, (4) five jaws.
71. ( ) In truing a live lathe center the compound rest is set at (1) 40 degrees, (2) 30 degrees, (3) 50 degrees, (4) 60 degrees, (5) 29 degrees.
72. ( ) The National Coarse thread corresponds to the old (1) S.A.E., (2) U.S.S., (3) N.S., (4) N.F.T.
73. ( ) A hexagon has (1) two sides, (2) three sides, (3) six sides, (4) four sides, (5) eight sides and eight angles.
74. ( ) The fractional equivalent of the decimal .0625 equals (1) ⅛ in., (2) ¼ in., (3) 1/16 in., (4) 1/64 in., (5) 1/6 in.
75. ( ) The work to be measured by micrometer calipers is measured between the (1) sleeve and the anvil, (2) anvil and the spindle, (3) thimble and the sleeve, (4) frame and the anvil.

Part IV

Completion test. (76–100) (25 points). Place the correct word in the space to make the sentence complete and correct. The figure in the parenthesis indicates the number of letters in the answer. Your score is the number of correct responses.

Example: A machinist's hammer has a *wood* (4) handle.

76. The accuracy of all contact measurements is dependent upon ..... (7) touch or feel.
77. The micrometer caliper is used to measure the ..... (7) diameter of a piece of stock.
78. Center holes are drilled with a ..... (11) drill and countersink.
79. The point of the soft lathe center must be ..... (4) and accurate.
80. .400 is indicated by the line 4 on the ..... (6) of the micrometer caliper.
81. The amount of taper is determined on the ..... (5) length of the piece of stock to be tapered.
82. The ..... (5) Standard Taper is used chiefly on head- and tailstock spindles of lathes and drill presses.
83. For accuracy in taper turning, the taper should be ..... (6) after taking a cut.
84. There are ..... (5) grades of knurling.
85. Turning or boring a taper by use of compound rest is one of the ..... (5) methods of taper turning and boring.
86. A drill chuck should be removed from the drill press spindle with a ..... (5).
87. The tool rest of the grinder should be set as ..... (5) as possible without touching the grinding wheel.
88. A lathe should be stopped by cutting off the ..... (5) and allowing the lathe to stop of its own accord.
89. While oiling a lathe, one should see that no part of the lathe is in ..... (6).
90. The tailstock of the lathe is set over for ..... (5) turning.
91. An external taper can be tested with a standard ..... (4) gauge.
92. Taper is usually stated by giving the difference in ..... (8) for one foot.
93. The compound rest of the lathe is graduated in ..... (7).
94. A threaded hole is an example of an ..... (8) thread.
95. The lead of a thread is the amount it will move into a nut in one ..... (10).
96. Use rapid indexing for ..... (7) a hexagon.
97. A piece of stock to be milled ¾ in. across the flats of a hexagon would have to be about ⅞ in. in ..... (8).
98. The dead or tailstock lathe center is always hard because it is stationary and the work ..... (8) on it.
99. Plenty of oil should be used during the knurling ..... (9).
100. Cylindrical work that has been drilled, bored, and reamed is usually further machined on a ..... (7) between centers of the lathe.

Part V

Matching (101–110) (10 points). In the two columns below are listed common machine-shop terms. Place in the parenthesis in front of the phrase in the left-hand column the identifying letter of the word or phrase in the right-hand column which is most closely related in meaning. Use each letter but once. Your score is the number right.

Example:

X. (N) Adhesive substance when fused or baked serves to hold the grains of the abrasive together. — N. bond (example)

101. ( ) A tool used for drilling center holes. — A. anvil
102. ( ) A steel or iron block upon which forging is done. — B. press fit
103. ( ) To fit parts together by pressure. — C. case harden
104. ( ) To form a hard, thin surface on metal. — D. headstock
105. ( ) A part of a lathe. — E. vise
106. ( ) The part of the drill that does the cutting. — F. twist drill
107. ( ) Difference in diameters per unit foot. — G. combination drill and countersink
108. ( ) An extremely hard, and more or less tough substance, which when fractured had many cutting edges and corners. — H. abrasive
109. ( ) A six-sided figure with six angles. — I. hexagon
110. ( ) An accurate measuring instrument. — J. micrometer caliper
K. shank
L. lip
M. taper

Recheck your work

Part VI

Rearrangement. (111–126) (16 points). Listed below are three common machine-shop operations. The proper steps are listed for carrying out the jobs, *but these steps are not in their proper order.* Examine each one in order and decide which step should come first, then number the other steps in the order that you should do them.

To Grind a Round Nose Lathe Tool Cutter Bit.

111. ( ) Grind the left side of the tool to the proper angle.
112. ( ) Grind the correct front clearance angle.
113. ( ) Grind the right side of the bit to the proper angle and shape.
114. ( ) Hone the cutting edge of the bit with an oilstone.
115. ( ) Grind the back rake on the bit.
116. ( ) Round the end of the tool bit.

To Tap a Hole.

117. ( ) Select the correct tap wrench.
118. ( ) Drill the correct sized hole for the tap.
119. ( ) Select the hand tap; either taper, plug, or bottoming.
120. ( ) Clamp the piece of metal to be tapped.
121. ( ) Tap the hole.

To Thread a Stud.

122. ( ) Select the proper die.
123. ( ) Clamp the work securely.
124. ( ) Cut the thread. Use cutting oil or compound on steel.
125. ( ) Prepare the stud for thread cutting.
126. ( ) Place the die in the die stock.

Go Back Over Your Work

KEY

Machine-Shop Test

(Answer sheet)

Name..... Grade..... Age..... A B C D E

Corrected by..... Hour..... Score.....

1. (Y) N	33. (T) F	64. (3)	95. revolution
2. (Y) N	34. (T) F	65. (4)	96. milling
3. (Y) N	35. (T) F	66. (4)	97. diameter
4. (Y) N	36. (T) F	67. (1)	98. revolves
5. (Y) N	37. (T) F	68. (1)	99. operation
6. (Y) N	38. (T) F	69. (3)	100. mandrel
7. (Y) N	39. (T) F	70. (3)	101. (G)
8. Y (N)	40. (T) F	71. (4)	102. (A)
9. Y (N)	41. T (F)	72. (2)	103. (B)
10. (Y) N	42. (T) F	73. (3)	104. (C)
11. (Y) N	43. T (F)	74. (3)	105. (D)
12. Y (N)	44. (T) F	75. (2)	106. (L)
13. Y (N)	45. (T) F	76. caliper	107. (M)
14. (Y) N	46. (T) F	77. outside	108. (H)
15. Y (N)	47. (T) F	78. combination	109. (I)
16. (Y) N	48. (T) F	79. true	110. (J)
17. (Y) N	49. T (F)	80. barrel	111. (2)
18. Y (N)	50. (T) F	81. total	112. (1)
19. (Y) N	51. (2)	82. Morse	113. (3)
20. Y (N)	52. (1)	83. tested	114. (6)
21. Y (N)	53. (2)	84. three	115. (5)
22. (Y) N	54. (2)	85. three	116. (4)
23. (Y) N	55. (3)	86. drift	117. (4)
24. (Y) N	56. (1)	87. close	118. (2)
25. (Y) N	57. (3)	88. power	119. (3)
26. T (F)	58. (1)	89. motion	120. (1)
27. (T) F	59. (1)	90. taper	121. (5)
28. (T) F	60. (4)	91. ring	122. (3)
29. (T) F	61. (1)	92. diameter	123. (1)
30. T (F)	62. (2)	93. degrees	124. (5)
31. T (F)	63. (1)	94. internal	125. (2)
32. (T) F			126. (4)

Table showing percentile of the frequency distribution for this industrial-arts test.

75 %-ile.....	76	30 %-ile.....	59	Possible score.....	120
70 %-ile.....	74	25 %-ile.....	56	Highest score.....	100
65 %-ile.....	72	20 %-ile.....	54	99 %-ile.....	97
60 %-ile.....	70	15 %-ile.....	53	95 %-ile.....	88
55 %-ile.....	68	10 %-ile.....	50	90 %-ile.....	84
50 %-ile.....	66	5 %-ile.....	47	85 %-ile.....	81
45 %-ile.....	64	1 %-ile.....	42	80 %-ile.....	78
40 %-ile.....	63	Lowest score.....	40		
35 %-ile.....	61	No. of cases.....	480		

APTITUDE TESTS FOR THE MACHINE SHOP

Robert S. Hunter*

High schools are interested in the guidance function. They are concerned with the many phases of guidanee and seek to give the pupil personal guidance, educational guidance, social guidance, moral guidance, recreational guidance, physical guidance, and vocational guidance. Of these different forms of guidance perhaps vocational guidance merits special consideration. Choosing a suitable vocation for life should not be a matter of minor moment. Certainly, the choice of a vocation should depend on more than the result of a whim or of a chance selection. Rather the selection should be based on an individual's aptitude as measured by standardized tests. What is the pupil's general scholastic aptitude and his rank in his class? What are his scores on special aptitude tests, for example, mechanical ability tests, clerical ability tests, scientific ability tests? All of these measures of a pupil's ability, taken together, will enable the psychologist or counselor to suggest to the pupil possible fields of vocational endeavor. When the tools of guidance, forged by the psychologist, are thus used, the guidance function will precede the training program.

In order that vocational guidance may function effectively, the selection of pupils for trade training should follow the recommendations of the psychologists to the end that greater numbers will achieve vocational adjustment. One such tool used by the psychologists, and of increasing importance, is the aptitude test for determining specific abilities, such as mechanical ability, etc. Many of the standardized tests now available purport to measure mechanical ability in general, but it is of more than passing interest to find tests which will discriminate abilities for particular trades. For example, some research has been accomplished in the field of mechanical drafting for the aptitudes necessary for success in that exacting field. In particular, the work of Crawford[1] brings to light a battery of tests suitable for predicting mechanical drawing aptitude. There appears to be, however, a dearth of aptitude tests which may be labeled "Aptitude Tests for the Machine Shop."

In this study an attempt has been made to determine the extent to which certain mechanical ability tests may be used in the selection of pupils for vocational training in the high school machine shop.

The Present Study

This study is based on a battery of tests given to sophomore and junior vocational machine shop pupils in Turtle Creek High School. The battery of tests included two types:

1. Standardized aptitude tests purporting to measure mechanical ability.
2. Shop performance tests which measured a pupil's ability to perform certain machine-shop operations. Three aptitude tests were administered to the majority of the pupils participating. Two of the tests used in this study had proved successful in determining mechanical drawing aptitude,[2] and one purpose of the present study was to discover to what extent these tests might be applied to differentiate machine-shop aptitude.

Age of the Groups: The age distribution of the sophomore group ranged from 14 to 18 years, giving an average age for 49 pupils of 15.4 years. Moreover, more than half of them were 15 years of age, and almost one third of them were 16 years of age. The 15- and 16-year-old pupils together comprised approximately 84 per cent of the group.

The age distribution of the junior group ranged from 15 to 19 years, and the average age for the 31 pupils participating was 16.2 years. Almost three fifths of them were 16 years of age, and approximately one sixth of them were 15 years of age. The 15- and 16-year-old junior pupils together comprised approximately 77 per cent of the group.

It will be seen that the 15 and 16 age levels predominate in both distributions. For the purpose of this study, a four fifths of a year's difference in the average age is not significant.

Aptitude Tests in the Battery: The three tests used in this study were suggested by William R. Grove, Department of Psychology, University of Pittsburgh.

The MacQuarrie Test for Mechanical Ability[3] is intended to furnish a first rough indication of aptitudes for acquiring manipulative skills. It requires some ability to recognize space relations, speed of decision and of movement, hand and eye co-ordination, muscular control, and visual acuity. It is a paper-and-pencil test which can be administered to an individual or to a group in about half an hour.

The Minnesota Paper Form-Board Test (AA)[4] furnishes an indication of ability to discriminate geometrical patterns in two dimensions. It measures, without the use of apparatus, somewhat the same abilities as are sampled by means of the Minnesota Spatial Relations boards and other form-boards. The Paper Form-Board does not permit manual manipulation, but it measures one component of mechanical aptitude.

The Crawford-Bennett Point-Motion Test (B):[5] Ability to comprehend and visualize how mechanisms operate is a large factor in the various phases of mechanical engineering. Potential engineers, designers, mechanical draftsmen and aspirants to kindred professions must possess this mechanism insight if they are to be proficient in their work.

When used below senior high school level, the Point-Motion Test must be carefully interpreted because of the type and difficulty of the items presented. The present norms are not applicable to a case where the person being tested does not grasp the general idea of the test items or does not understand the schematic drawings. However, any person who has had elementary drawing or sketching in high school and can read a blueprint should not experience difficulty in understanding the items on this test.

Administering the Aptitude Tests: The test battery was administered to the sophomore class of 1945 and to the junior class of 1944 in the Turtle Creek High School vocational machine shop. In order that the pupils would work to the best of their abilities, an attempt was made to gain en rapport. The MacQuarrie Test for Mechanical Ability was given first and was followed by the Minnesota Paper Form-Board Test, and finally, the Crawford-Bennett Point-Motion Test was administered. After each test, they were scored as quickly as possible, and the average score for the groups was computed. Since their showing on the test appeared favorable, they were told that such was the case.

The Mental Ability Test in the Battery: No testing of aptitudes would be complete without some measurement being taken of general intelligence. No special test was given to discover the intelligence rating because such information was available in the high school files. Unfortunately, it was only possible to obtain scores for 42 of the sophomores and 24 of the juniors. Some students taking the machine-shop course had come from other school districts and had taken the Henmon-Nelson, but not the Otis (B) test. The I.Q.'s obtained were the Otis (B) Intelligence Test data. Since the test had been administered in 1942 to the sophomore group and in 1941 to the junior group, they are comparatively recent indices of intelligence. The mean I.Q. achieved by the group corresponds to a Binet Mental Age of 14 years 4 months.

Criterion Score

In studies of this sort, the criterion score quite frequently chosen is the instructor's final mark for the course. If the mark is the result of objective measurement, this grade is probably as reliable an index as is possible to obtain. But when two or more instructors' grades are used for research studies, a feasible source of error creeps in (unless it has been demonstrated that objective measurements are used to obtain the final marks or grades). Often other not easily measured factors become part of the grade; for example, pupil attitude, conduct, effort, work habits, etc. Inasmuch as this present study combines data from two shop teachers' classes, the use of semester grades for the criterion score was thought not to be satisfactory.

It is common knowledge that machine-shop work lends itself to precise and accurate measurement. Measurement to a thousandth of an inch is the rule rather than the exception. This fact made it possible to select a job for the pupils and to measure the result to within the tolerances prescribed for the test. Measurement alone, however, is not enough; the time taken to complete the job to within the required specifications may be just as important. In particular, industry places great emphasis upon the time factor. To increase the validity of the performance tests, the majority of the sophomores were judged by their showing on two different performance tests while the majority of the

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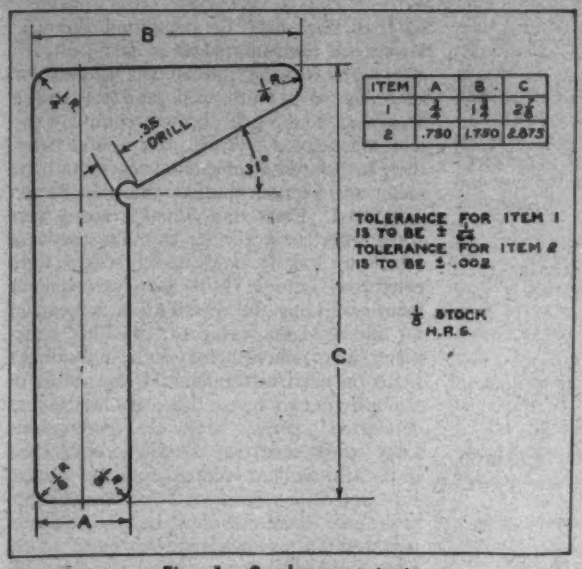

ITEM	A	B	C
1	1/2	1 3/4	2 5/8
2	.750	1.750	2.875

Fig. 1. Sophomore test

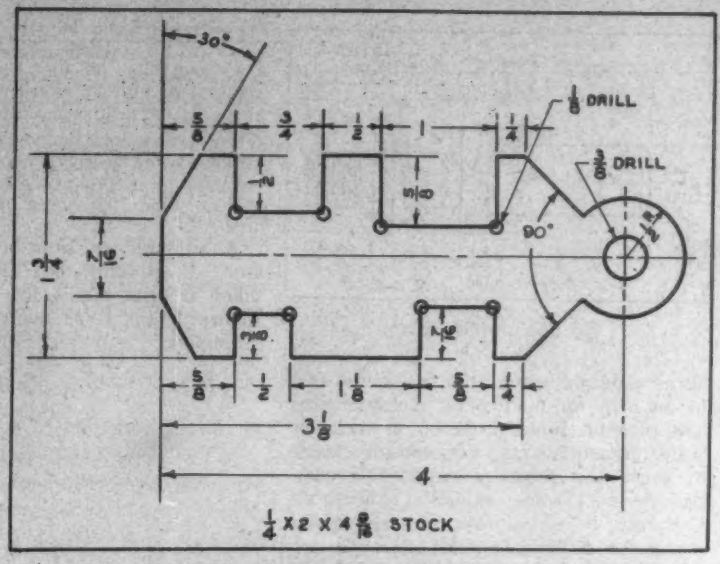

Fig. 2. Sophomore test

juniors were judged by their performance on three tests. These tests were administered at the end of each semester in the school year 1942–43. Hence, they represent a sampling of the work done and operations covered for the year. Thus, the performance tests used for the criterion made it practicable to determine the accuracy, the finish or quality, and finally, the time it took each student to complete the test.

Selecting the Performance Tests: It should be known that benchwork is stressed during the sophomore year. Since the work of the all-round machinist includes the use of hand tools, such as scrapers, chisels, files, etc., benchwork should not be slighted. In addition, the all-round machinist may be expected to fit and assemble machine parts in which skill in the use of hand tools is important.

The test job selected for the sophomore group is shown in Figure 1. Moreover, the job is similar to one which they had already completed as part of the work of the course. Because speed in performance was an element of the testing, the pupils were not expected to meet a new learning situation. The second sophomore test is shown in Figure 2.

The jobs assigned to the junior group appear in Figures 3 and 4. The tests included both bench and lathe jobs, but they offered no new learning situations because the jobs selected and the operations covered were similar to ones which they had already completed.

Administering the Performance Tests: The writer, in cooperation with the sophomore shop teacher, supervised the performance testing. A boy from the junior shop was detailed to act as timekeeper. The pupils started the test in groups of four or five, and a time sheet was prepared for each one. Items on the time sheet included *time started, time stopped,* and *actual working time.* Only the actual working time was used. Time lost waiting for the use of a tool or for other personal reasons was not included as part of the working time. When a boy stopped work, he reported to the timekeeper who made a note of the time. When the boy was ready to resume work, he also told the timekeeper. The pupil turned the job in when it was completed to his satisfaction. No help was given during the progress of the test; he was permitted to use his own judgment. If an error was made, he could start the job over, but the initial starting time was the one used.

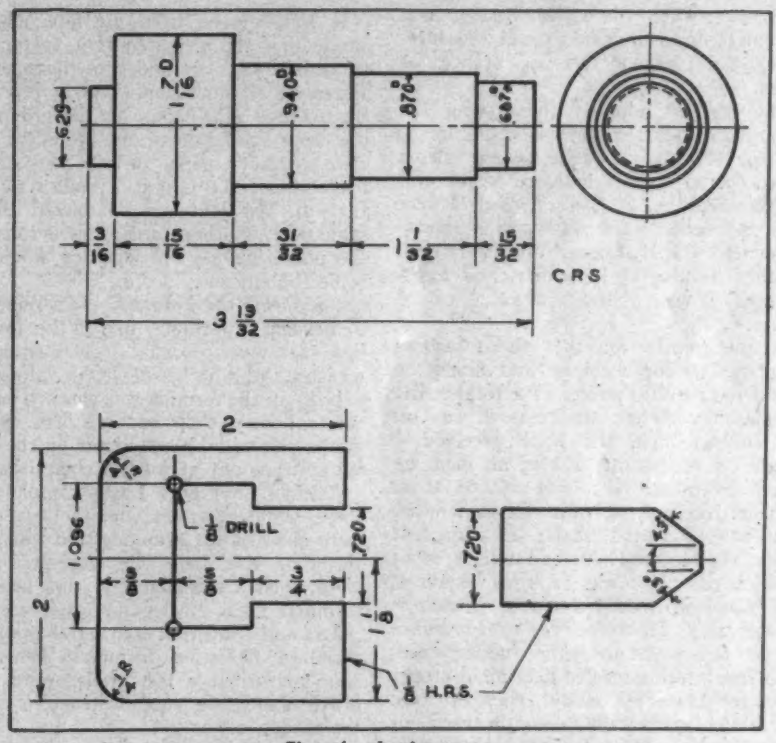

Fig. 4. Junior test

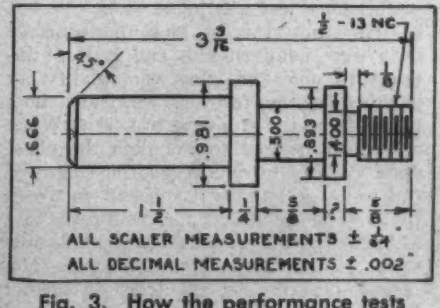

Fig. 3. How the performance tests are checked

For the junior tests only two of the lathes were used to permit uniformity of testing conditions. The lathes used were 9-inch South Bend bench lathes with quick change gear boxes. Hence, it was possible to allow the pupil to apply his knowledge of speeds and feeds.

Scoring the Performance Tests: In all of the tests taken by the pupils the toler-

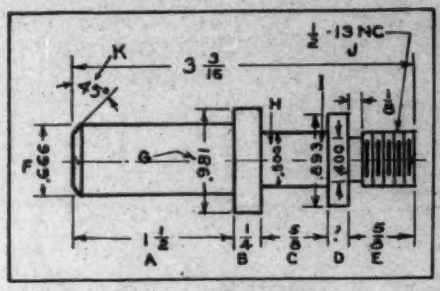

Fig. 5. Junior test

ances required were plus or minus .002 of an inch for micrometer measurements and plus or minus 1/64 of an inch for scalar measurements. For certain classes of work, the accuracy required is comparable with some industrial tolerances. Certainly, it meets the industrial requirements for roughing operations.

After the student had stenciled his initials on the job, it was brought to the junior shop where the writer checked each micrometer measurement, scalar measurement, and judged the appearance or "finish."

The method adopted for scoring the performance tests is shown in Figure 3. The point value for the measurements shown was arbitrarily assigned as follows: measurements A, B, C, D, E, and K were each assigned a value of 5 points; measurements F, G, H, I, and Finish were each assigned a value of 10 points; and measurement J was assigned a value of 20 points.

If the pupil's job met the foregoing specifications for accuracy and finish, he would receive 100 points as a total score. If one micrometer measurement was off .001 of an inch, the pupil received 9 points; if it was off .002 of an inch, he received 8 points; if it was off .003 of an inch, he received no points for that measurement. For each scalar measurement within the required plus or minus 1/64 of an inch the pupil was awarded 5 points.

A Formula Which Includes Accuracy, Finish, and Time for the Performance Tests: It is well known that industry uses time study techniques to determine proper incentive rates for many types of jobs. For many years it has seen the need for exact procedures in determining time values. This study recognizes the value of time as an element in production and attempts to seek a solution for the problem in the school shop.

The formula used to determine the efficiency score is as follows:

$$E = P \pm P\,Sq$$

where E = Pupil efficiency as measured by accuracy, finish, and time.

P = Total points for accuracy and finish.

Sq = Speed quotient. The speed quotient may be defined as the per cent increase or decrease of 3 times the average time taken for the test job. It is the ratio of

$$\frac{\text{The average time on the job} - \text{the working time}}{3 \times \text{average time}}$$

or

$$\frac{\text{The working time on the job} - \text{the average time}}{3 \times \text{average time}}$$

When the average time is greater than the working time, the speed quotient is positive; but when the working time is greater than the average time, the speed quotient becomes negative.

An example will show how the efficiency score, E, is computed. The average time taken by the pupils for the bench job, Figure 3, was 10.23 hours.

Example:

$$E = P \pm P\,Sq$$
$$= 63 + (63 \times .069)$$
$$= 63 + 4$$
$$= 67$$
$$Sq = \frac{(10.23 - 8.12)100}{(3 \times 10.23)}$$
$$= \frac{(2.11)100}{(30.69)}$$
$$= 6.88 \text{ per cent}$$

It will be seen from the foregoing example that the weighted time factor is a variable. Points are added to the accuracy scores on all jobs completed in less than the average time taken by the group. On the other hand, points are subtracted from the accuracy scores on all jobs taking longer than the average time. Assuming that all the jobs are completed in the same time, in other words, time is constant, the points gained for accuracy would become the efficiency score.

Validating the Formula: It is one thing to develop a formula, but if the formula does not measure what it is intended to measure, it will be of little value. The validity of the formula was checked against the sophomore shop teacher's first semester grades. He rated his students on the quality and amount of work accomplished.

The job in Figure 1 was completed by the sophomore group, and the test pieces were checked for accuracy and finish and the time recorded. The efficiency scores were then calculated by the foregoing formula. These efficiency scores were computed and converted into letter grades by standard deviation formulas. When the shop performance test grades were correlated against the shop instructor's semester grades, r was .64.

The coefficient of validity for one shop performance test was found to be .64, but in this study two or more performance tests were administered, and it is of interest to note the effect on validity by lengthening the test or, which amounts to the same thing, giving two tests. When a formula is used to calculate the effect upon validity by increasing the length of the test, the validity coefficient increases to .71. The conclusion may be drawn, that although the performance tests only sample some of the work of the machine-shop course, nevertheless, the tests do predict fairly accurately the progress of the pupil in machine-shop work.

Calculating the Criterion Score: The method employed in the treatment of the criterion data is one recommended by Garrett[6] for reducing scores to a common basis so that they may be compared directly. It will be remembered that each test administered to the pupils was scored for accuracy on a point basis and the length of time it took each pupil to complete the test was noted. These raw scores were then calculated as efficiency scores and the mean and sigma values of the distribution computed. Each individual's score was transmitted to a z score to make the data easier to handle, and the z scores were converted into a still more convenient form by giving the distribution a mean of 50 and a sigma value of 14. This treatment was followed for each individual's score on each test taken. If the scores of a pupil in two tests, then, are written as converted scores, they are comparable since they are expressed in equivalent units. Equivalent scores may be added, subtracted, or averaged. For example, suppose one of the sophomores achieves in two tests a mean converted score of 50 and suppose a junior pupil's mean converted score in three tests is 50. Although the tests were different in content, the sophomore and junior scores represent the same level of achievement in the test battery. The use of equivalent scores made it practicable to combine the sophomore and junior scores as a whole. This would not have been possible if the raw scores had not been converted to some standard scale.

Correlating the Test Battery

The criterion score has been discussed at some length; it remains now to consider the treatment of the aptitude test data. Before the testing program had been completed a few of the sophomores and juniors took advantage of the favorable employment opportunities to secure work. Although these dropouts had taken only some of the tests, it was thought desirable to use what tests had been taken for correlation purposes. Such a condition brought about inequalities in the size of the sampling. Consequently, the treatment of the data was not as rigorous as might be wished.

TABLE I (a). Correlation of Test With Criterion

N	*Tests*	*Criterion score*
75	Minnesota Paper Form Board Test (AA)	.453
77	MacQuarrie Test for Mechanical Ability	.371
66	Otis Mental Ability Test (B)	.283
75	Crawford-Bennett Point-Motion Test (B)	.272

TABLE I (b). Intercorrelation of the Tests

N	*Tests*	*Crawford-Bennett Point-Motion(B)*	*Minnesota F.B.(AA)*	*Mac Quarrie*
78	Minnesota F. B. (AA)	.255	——	——
77	MacQuarrie	.364	.331	——
65	Otis (B)	.126	.172	.250

When the criterion score is correlated with the other tests in the battery, the results are shown in Table I (a). It will be noted that the Minnesota Paper Form

Board (AA) is the best single test in the battery for predicting machine shop aptitude. Crawford[7] (in his study) also found that the Minnesota Paper Form Board Test (AA) was the best single test for predicting mechanical drafting aptitude. He reports a correlation of .498 with final course marks. The agreement of the correlations for the Minnesota Paper Form Board Test (AA) in Crawford's research and the present study is not surprising since the reading of blueprints is an important tool in the machinist's trade. An aptitude for one presupposes, to some degree, an aptitude for the other.

The intercorrelations of the tests are shown on Table I (b). When the tests in the battery show low correlations with each other, it means that the abilities they measure are not equivalent. The low correlation of the Otis B Test with the other tests in the battery shows that it measures abilities distinct from mechanical ability per se. Unfortunately, the number of pupils whose I.Q.'s were available does not compare with the number of pupils who took the aptitude tests. For this reason, some doubt should be cast upon the Otis B Test data.

The Regression Equations: From the data in Tables I (a) and I (b), a number of regression equations were calculated. These data appear in Table II. Various combinations of the tests were tried in order to discover the best combination the data provided to predict aptitudes for machine-shop work. A regression equation was computed for the Minnesota Paper

TABLE II. The Regression Equations

Score form	PE (Est. x_1)	R
1. $x_1 = .42x_2 + 32.9$	7.1	.453
2. $x_1 = .59x_3 + .37x_5 + 26.7$	7.0	.469
3. $x_1 = .23x_2 + .40x_3 + 12.6$	6.9	.489
4. $x_1 = .36x_2 + .20x_4 + .34x_5 + 18.8$	6.9	.500
5. $x_1 = .26x_4 + .34x_5 + 19.9$	6.8	.520
6. $x_1 = .18x_2 + .23x_4 + .33x_5 + 5.7$	6.7	.529

where: x_1 = Estimated Score
x_2 = Score on Crawford-Bennett Point-Motion Test (B)
x_3 = Score on Otis Mental Ability Test (B)
x_4 = Score on MacQuarrie Test for Mechanical Ability
x_5 = Score on Minnesota Paper Form Board Test (AA)

Form Board Test (AA) because this test gave the best single correlation with the criterion. It is of interest to note that equation 5 using only two of the aptitude tests, namely, the Minnesota Paper Form Board and the MacQuarrie, gave a higher coefficient of multiple correlation (R) than a three-test battery which includes Crawford-Bennett Point-Motion, MacQuarrie, and Minnesota Paper Form Board. Equation 6 gave the best coefficient of multiple correlation with the least probable error of the estimate x_1. This equation includes the Otis B, MacQuarrie, and Minnesota Paper Form Board tests. Pending a larger sampling, the value of equation 6 may be in doubt for reasons already mentioned. If it is thought that a battery of tests should include some measure of an applicant's general intelligence, the army occupational data will indicate the critical scores for occupations such as machinist and toolmaker. Should the applicant's score come within the required range, the use of equation 5 will determine the applicant's mechanical aptitude as measured by the Minnesota Paper Form Board and the MacQuarrie tests.

The value of any regression equation is the extent to which it measures better than the chance situation. This is usually calculated as a percentage of efficiency and depends on its correlation with the criterion.

The percentage of efficiency shown for two of the equations is as follows:

Equation	Test	Per cent of efficiency
1	Minnesota Paper Form Board (AA)	10.7
5	Minnesota Paper Form Board (AA) MacQuarrie	14.6

Facilitating Tables: Facilitating tables have been devised for use with two of the equations, namely, equation 1 and equation 5. Table III gives the facilitating data for use with the Minnesota Paper Form Board Test. The raw scores may be easily converted into estimated final scores from which the predicted grades are found.

MINNESOTA PAPER FORM BOARD (AA)
TABLE III. Predicting Letter Grades from Scores on the Minnesota Test

Columns 1	2	3	4	5
Raw test score	x_1 Estimated score	Deviation from mean in sigma units	Deviation score	Predicted letter grade
60	58.1	2.0	60.1	A
59	57.7	1.9	59.5	A
58	57.3	1.8	58.8	A
57	56.8	1.7	58.2	A
56	56.4	1.6	57.5	A
55	56.0	1.5	56.9	B+
54	55.6	1.4	56.2	B+
53	55.2	1.3	55.6	B+
52	54.7	1.2	54.9	B+
51	54.3	1.1	54.3	B+
50	53.9	1.0	53.7	B
49	53.5	.9	53.0	B
48	53.1	.8	52.4	B—
47	52.6	.7	51.7	B—
46	52.2	.6	51.1	B—
45	51.8	.5	50.5	C+
44	51.4	.4	49.8	C+
43	50.9	.3	49.1	C+
42	50.5	.2	48.5	C+
41	50.1	.1	47.9	C+
40	49.7	0	47.2	C
39	49.3	—.1	46.6	C
38	48.9	—.2	45.9	C
37	48.5	—.3	45.3	C—
36	48.0	—.4	44.5	C—
35	47.6	—.5	44.0	C—
34	47.2	—.6	43.3	D+
33	46.7	—.7	42.7	D+
32	46.3	—.8	42.1	D+
31	45.9	—.9	41.4	D+
30	45.5	—1.0	40.7	D
29	45.1	—1.1	40.1	D
28	44.7	—1.2	39.5	D
27	44.3	—1.3	38.8	D—
26	43.8	—1.4	38.2	D—
25	43.4	—1.5	37.5	D—
24	43.0	—1.6	36.9	E
23	42.6	—1.7	36.2	E
22	42.1	—1.8	35.6	E
21	41.7	—1.9	34.9	E
20	41.3	—2.0	34.3	E
19	40.9			
18	40.5			
17	40.0			
16	39.6			
15	39.2			
14	38.8			
13	38.3			
12	37.9			
11	37.5			
10	37.1			
9	36.7			
8	36.3			

Example: An applicant receives a score of 47 on the Minnesota Paper Form Board Test. What is his probable grade in machine shop? His estimated score is 52.6 (column 2), and column 4 shows that a deviation score of 51.7 corresponds to a predicted letter grade of B—. Such a score is also .7 of a standard deviation from the mean.

The critical score for the Minnesota Paper Form Board Test was found to be 25. Of the ten pupils who received this score or less, only one achieved higher than a D grade when measured by a shop performance test. All of the F shop grades were found in this group. It does not follow, however, that scores above 25 will not produce any D grades. On the contrary, 14 per cent of them received D grades, but 86 per cent of the scores above 25 were given C shop grades or better.

No matter how good a measure one test may prove to be, it is not enough; two or more tests should be employed for prediction purposes. The two tests used (equation 5) when employed as a battery gave a better multiple coefficient of correlation (R) than the three test battery in equation 4.

Table IV provides the facilitating data for use with the Minnesota Paper Form Board and MacQuarrie tests. When the individual scores are substituted in equation 5, the weights for each test may be calculated from the equation and total scores found. Thus:

$$x_1 = W_4 + W_5.$$

After the total scores are obtained, it is easy to find the probable estimated grade. An example will show how this is done.

TABLE IV. Weighted Scores for the Minnesota Paper Form Board (AA) and MacQuarrie Tests

MacQuarrie Test for Mechanical Ability		Minnesota Paper Form Board (AA)	
Raw test score	W_4	Raw test score	W_5
89	43.1	60	20.4
88	42.8	59	20.0
87	42.5	58	19.7
86	42.3	57	19.4

MacQuarrie Test for Mechanical Ability		Minnesota Paper Form Board (AA)	
Raw test score	W_4	Raw test score	W_5
85	42.0	56	19.0
84	41.7	55	18.7
83	41.4	54	18.4
82	41.2	53	18.0
81	40.9	52	17.7
80	40.7	51	17.3
79	40.5	50	17.0
78	40.2	49	16.7
77	39.9	48	16.3
76	39.6	47	16.0
75	39.4	46	15.6
74	39.1	45	15.3
73	38.9	44	15.0
72	38.6	43	14.6
71	38.4	42	14.3
70	38.1	41	13.9
69	37.8	40	13.6
68	37.6	39	13.3
67	37.3	38	12.9
66	37.0	37	12.6
65	36.8	36	12.2
64	36.5	35	11.9
63	36.3	34	11.6
62	36.0	33	11.2
61	35.7	32	10.9
60	35.5	31	10.5
59	35.2	30	10.2
58	35.0	29	9.86
57	34.7	28	9.51
56	34.4	27	9.20
55	34.2	26	8.84
54	33.9	25	8.50
53	33.7	24	8.16
52	33.4	23	7.83
51	33.2	22	7.47
50	32.9	21	7.15
49	32.6	20	6.80
48	32.4	19	6.46
47	32.1	18	6.11
46	31.9	17	5.78
45	31.6	16	5.44
44	31.3	15	5.10
43	31.1	14	4.76
42	30.8	13	4.42
41	30.6	12	4.07
40	30.3	11	3.72
39	30.0	10	3.40
38	29.8	9	3.06
37	29.5	8	2.72
36	29.3		
35	29.0		
34	28.7		

TABLE IV(a). Predicting Final Grades in Machine Shop From Weighted Scores on Minnesota and MacQuarrie Tests

Deviation from mean in sigma units	Deviation score		Predicted letter grades
2.0	66.2		
1.9	65.3		
1.8	64.4		A
1.7	63.5		
1.6	62.5		
1.5	61.6		
1.4	60.7		
1.3	59.8	B+	
1.2	58.9		
1.1	58.0		
1.0	57.1		B
.9	56.2		
.8	55.2	B—	
.7	54.3		
.6	53.4		
.5	52.5		
.4	51.6		
.3	50.7	C+	
.2	49.7		
.1	48.8		
0	47.9		C
—.1	47.0		
—.2	46.1		
—.3	45.2	C—	
—.4	44.2		
—.5	43.3		

Deviation from mean in sigma units	Deviation score		Predicted letter grades
—.6	42.4		
—.7	41.5		
—.8	40.6	D+	
—.9	39.7		
—1.0	38.7		D
—1.1	37.8		
—1.2	36.9		
—1.3	36.0	D—	
—1.4	35.1		
—1.5	34.2		
—1.6	33.3		
—1.7	32.3		
—1.8	31.4		E
—1.9	30.5		
—2.0	29.6		

Example: For a score of 75 on the MacQuarrie Test and a score of 50 on the Minnesota Paper Form Board Test the best estimated score is

(See Table IV.)

$$x_1 = W_4 + W_5$$
$$= 39.4 + 17.0$$
$$= 56.4$$

A glance at Table IV (a) shows that the foregoing score gives a B— letter grade.

A critical score for the Minnesota test has been suggested; it remains now to determine the critical scores for the combined Minnesota and MacQuarrie tests. A low score on one test may not be conclusive, but two low scores on two different tests purporting to measure mechanical ability may be considered a danger signal. Accordingly, the critical scores for the Minnesota and MacQuarrie tests are 24 and 53 respectively. A study of the data indicates that of the nine pupils who received scores less than the above critical scores only two of them were awarded performance test grades higher than a D. Moreover, all of the F shop performance test grades were contained in this group.

Applying the Minnesota Regression Equation in a New Sampling

The foregoing has developed regression equations for use with one or more aptitude tests. The regression equations were developed from one sampling, but their value depends upon the extent to which they are true for any new testing situation. The assumption is that any such regression equation will be true within the limits of the probable error of the estimate. Were this not the case a regression equation would have little value other than for the sampling from which it was developed.

It is of interest, therefore, to apply the formula to a different group to further test its effectiveness. To this end, an incoming group of sophomore machine-shop pupils was tested with one of the aptitude tests, namely, the Minnesota Paper Form Board Test. The tests were scored, and from Table III the predicted machine-shop grade was tabulated for each individual taking the test. It will be needless to add that the sophomore shop teacher was not informed of the results of the tests.

After the first six weeks' period the shop teacher rated the pupils on the work they had accomplished up to that time. It might be added that one six weeks' period of the school term includes only three weeks or ninety hours of actual shop work. The ratings for the second six weeks' period were also tabulated.

When the Minnesota Paper Form Board Test was scored, it was found that there were 16 B predicted grades (see Table V). It is certainly of interest to discover how the shop grades follow the prediction. Obviously, if nearly all of the predicted B grades turned out to be D grades, high scores on the aptitude test would be meaningless. It is seen in the figure that half of the B predicted grades produced B shop grades. Slightly more than three tenths of them were C grades and almost one fifth of them D grades. Of the 23 C predicted grades one twelfth of them were B shop grades, almost one half were C shop grades, and slightly more than one third of them were D grades. Of the three D grades which the formula predicted, one of them was a C grade while the other two were D grades. It may be concluded that although an individual receives a high score on the Minnesota test it does not follow that he will actually receive a high grade in shop. However, the chances are four out of five that he will receive a B or C grade and only one chance in five that he will receive a D grade in machine-shop work. Moreover, individuals with C predicted grades have a 50-50 chance of receiving that grade in shop, but those who fail to receive the C shop grade will more likely get D than B grades.

TABLE V. A Comparison Showing the Number of Predicted Grades and a Distribution of Actual Shop Grades

	Per cent	Actual shop grades
16 B Predicted grades	50.0	BBBBBBBBBBBBBBBB
	31.3	BBBBBBBBB
	18.7	CCCCCCCCCCCCCCCC
23 C Predicted grades	13.0	DDDDDDDDDD
	47.8	BBBBBBB
	34.8	CCCCCCCCCCCCCCCC CCCCCCCC
	4.4	DDDDDDDDDDDDDD DDDD
3 D Predicted grades	33.3	FF
	66.7	CCCCCCCCCCCCCCC CC
		DDDDDDDDDDDDDD DDDDDDDDDDDDDD DDDDDDD

Legend: B = B grades, C = C grades, D = D grades, F = F grades

The foregoing brings to light the limitations involved when using only one test for prediction purposes. That the regression equation does not predict with unerring accuracy is apparent. Approximately 50 per cent of the predicted grades were the actual grades received by the pupils during the testing period under consideration. That the equation is a useful tool for predicting machine-shop aptitude makes it a valuable instrument when counseling individuals interested in the machine-shop field. Certainly the use of it should prevent many likely failures and thereby provide a component of job satisfaction which is aptitude for the work.

Conclusions

The use of such tests in the selection of applicants for high school vocational work may well be considered. When a boy selects machine shop as a vocation, he does so with the thought that he will eventu-

ally become a machinist in industry. Tests of the above type could be used as a step in selecting individuals who want to devote their energies as machinists for a life's work. Happy adjustment in a vocation is of primary importance to the individual's well-being. Industry wants its personnel to be satisfied with their jobs. Those who might become misfits in the trade could be discovered before considerable effort was wasted. The three years of frustrating energy could be saved and redirected along the channel the individual's talents appeared to lie.

Dependence upon one test or even two is not enough; other positive evidence of an individual's aptitude should be obtained. Cumulative records, grades in junior high school, interest inventories, personality ratings, etc., could be studied for signs pointing to the desired aptitude. Vocational guidance based on fact is to be preferred to guidance based on fancy.

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TEST FOR AIRCRAFT DETAIL DRAFTING CLASSES

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In the following test are 100 statements. Some are true, others are false. If the statement is a true one, place a "T" before same; if statement is not correct, place an "F" before it. To compute your rating deduct 1.5 per cent for each statement answered incorrectly from 100 per cent.

( ) 1. The fundamental principles of orthographic projection are used in aircraft drafting.
( ) 2. The lettering used on all aircraft drawings is highly embellished, and always vertical.
( ) 3. Letters and numerals are always placed on an aircraft drawing to read in a vertical direction.
( ) 4. Practically all drawings are made in pencil, on vellum.
( ) 5. An ink tracing is usually made for reproduction purposes in aircraft drafting.
( ) 6. The standard letter size, 8½ by 11 in., is used by the Douglas Aircraft Co. as the basic size for folding prints.
( ) 7. All aircraft manufacturers use the same system for numbering drawings.
( ) 8. All dimensions must be given in either feet or inches.
( ) 9. The title block is located in the lower left-hand corner.
( ) 10. All steel parts and bearings are cadmium plated.
( ) 11. All dimensions on a drawing are given in fractions.
( ) 12. The word *ship* is accepted as an abbreviation of airplane.
( ) 13. Threaded bolts and screws are standardized by the Bureau of Standards, U. S. Dept. of Commerce.
( ) 14. The angle of a Sellers thread is 45 deg.
( ) 15. Three series of threads are commonly used in aircraft drafting.
( ) 16. A Class 1, Loose Fit, is used for rough, commercial quality threads.
( ) 17. A Class 4, Close Fit, is a better fit than a Class 3, fit.
( ) 18. N F-2 indicates a National fine series thread with a class 2, close fit.
( ) 19. No. 4-40 on a drawing means number 4 size, 40 threads per inch.
( ) 20. No. 7/16-20 on a drawing means 7/16" dia. and 20 threads per inch.
( ) 21. The pitch line is the line on which the space between two adjacent threads is the same as the distance across the thread.
( ) 22. When indicating threads on an aircraft drawing it is necessary that the alternating thick and thin lines be vertical.
( ) 23. The tap drill is the nearest standard size drill to the minor diameter of the thread.
( ) 24. Standard notes are seldom placed on drawings of threaded units.
( ) 25. Oval head screws are usually large in size.
( ) 26. The head of an oval screw is slotted instead of being recessed.
( ) 27. Tolerances and fits control the interchangeability of airplane parts.
( ) 28. All parts for the same plane are constructed in one manufacturing plant.
( ) 29. A limit is the maximum or minimum permissible length of a given dimension.
( ) 30. Tolerance is the amount of variation allowed on any dimension.
( ) 31. The basic size of a part is the approximate size from which all limiting variations are measured.
( ) 32. The nominal size is the exact size.
( ) 33. The term *fit* refers to the tightness or looseness with which mating parts assemble and operate.
( ) 34. There are no absolute rules for figuring tolerances.
( ) 35. A bolt that is threaded on a lathe is 0.007 oversize.
( ) 36. Threaded bolts and screws are seldom chamfered.
( ) 37. Parts that are rotated (bearings) always require a medium fit.
( ) 38. The abbreviation for absolute ceil- is ac.
( ) 39. The abbreviation for fuselage is fus.
( ) 40. The abbreviation for aileron is A.
( ) 41. The abbreviation for battery is bat.
( ) 42. Brkt. is the correct abbreviation for Bulkhead.
( ) 43. "Con" is the abbreviation used on all aircraft drawings for the word control.
( ) 44. The correct abbreviation for the word cowling is cow.
( ) 45. The abbreviation for draftsman is dftsmn.
( ) 46. The abbreviation for elevator is elev.
( ) 47. Drawing has the abbreviation of dwg.
( ) 48. The word stock length is always abbreviated S.L.
( ) 49. The abbreviation for stabilizer is S.
( ) 50. The abbreviation for rear is rr.
( ) 51. Aluminum is produced from pure aluminum oxide by an electrolytic process.
( ) 52. Six tons of bauxite ore are necessary to produce one ton of aluminum.
( ) 53. Aluminum is mixed with alloys to increase its strength.
( ) 54. Duralumin, the aluminum alloy, has for its trade mark the word "Luxor."
( ) 55. A die casting, due to its rough surfaces, is difficult to machine.
( ) 56. A die casting is covered with sand when removed from its mold.
( ) 57. High quality aluminum and magnesium castings are made with special equipment and techniques.
( ) 58. High quality die casting equipment is made by the Harvie Aircraft Die Casting Corp. of Los Angeles, Calif.
( ) 59. Metal is heated to a molten state in forging.
( ) 60. Most of the forged aircraft parts are made by hand, due to the lack of dies and power hammers.
( ) 61. The ultimate strength of aircraft steel depends upon alloys and heat treatment.
( ) 62. Carbon steel, chromium steel, and molybdenum steel have different ultimate strengths.
( ) 63. Nickel steel is harder than tungsten steel.
( ) 64. All aircraft steels are numbered on an aircraft drawing according to a definite system.
( ) 65. Sheet steel is never used to make aircraft fittings.
( ) 66. Carbon steel is used for airplane nuts, machine screws, and other low stressed structures.
( ) 67. Bar steel bolts are widely used because of the great shearing strength of this material.
( ) 68. Steel tubing is made from mild carbon steel.
( ) 69. Wires may be classed as hard, stranded, and tie rods.
( ) 70. A hard wire is a double strand of low strength steel.
( ) 71. Stranded wire is a miniature cable.
( ) 72. Tie rods are single strands with threaded ends and are made with cross sections that are round, square, or streamline.
( ) 73. The nonflexible type cable is usually used on pulleys.
( ) 74. The wood pattern used in sand casting is made of either maple or birchwood.
( ) 75. The patternmaker is a very skilled craftsman.
( ) 76. The molten metal is forced into a sand casting by pressure.
( ) 77. The mold is destroyed when the sand casting is removed from the sand.
( ) 78. Dash numbers are numerals used for identification purposes on aircraft drawings.
( ) 79. Dash numbers are prefixed with a dash and enclosed with a ⅝-in. circle.

( ) 80. Dash numbers are classified under five different headings.

( ) 81. The word extrude means to force, press, or push out.

( ) 82. The process of manufacturing extrusions consists in forcing plastic materials through a die having an aperture of the desired contour.

( ) 83. The materials used for aircraft extrusions are usually brass alloy and nickel silver.

( ) 84. Various extrusion shapes are identified by Alcoa die numbers.

( ) 85. A temporary connection in airplane structure is either welded, brazed, or riveted.

( ) 86. In most riveted joints the pieces of metal joined together are usually thin sheets.

( ) 87. The brazier type rivet is used exclusively in aircraft structure.

( ) 88. All AN rivets have *coded* designations to indicate their type, material, diameter, and length.

( ) 89. The heads of all bolts used in aircraft structure are marked to insure clear identification.

( ) 90. The AN standard book is issued by the United States Steel Corp.

( ) 91. All standard aircraft bolts are copperplated.

( ) 92. The machines used in the fabrication of airplane parts are classified under two general headings, cutting and forming machines.

( ) 93. A punch press is classified as a forming machine.

( ) 94. Dimensions are not placed on an assembly drawing.

( ) 95. Information, such as instructions for drilling and reaming are always omitted on an aircraft assembly drawing.

( ) 96. Welded assemblies are usually of copper tubing, or of copper sheet, or a combination of both, in aircraft structures.

( ) 97. The techniques and equipment used in spot welding and torch welding are identical.

( ) 98. Lofting is an important feature of aircraft drawing in which the engineers design is transposed into actual three-quarter size physical structures.

( ) 99. The engineering department supplies the loft with freehand sketches of the major components of the airplane.

( ) 100. In order to standardize and allow less chance for errors, it is usual to loft all lines as viewed from the front of the airplane and showing the right side.

References: *Aircraft Detail Drafting*, by Meadowbrook (Service Engineer, Douglas Aircraft Corp., Los Angeles, Calif.) and *Engineering Drawing* by French (1941 edition) (New York: McGraw Hill Book Co.).

KEY FOR TEST — AIRCRAFT DETAIL DRAFTING

1. T	9. F	17. T	25. F	33. T	41. F
2. F	10. F	18. F	26. F	34. T	42. T
3. F	11. F	19. T	27. T	35. F	43. F
4. T	12. F	20. T	28. F	36. F	44. F
5. F	13. T	21. T	29. T	37. F	45. T
6. T	14. F	22. F	30. T	38. F	46. T
7. F	15. T	23. T	31. F	39. T	47. T
8. F	16. T	24. F	32. F	40. F	48. T
49. F	58. T	67. F	76. F	85. F	94. F
50. T	59. F	68. T	77. T	86. T	95. F
51. T	60. F	69. T	78. T	87. F	96. F
52. F	61. T	70. F	79. F	88. T	97. F
53. T	62. T	71. T	80. F	89. T	98. F
54. F	63. F	72. T	81. T	90. F	99. F
55. F	64. T	73. F	82. T	91. F	100. F
56. F	65. F	74. F	83. F	92. T	
57. T	66. T	75. T	84. T	93. F	

QUIZ FOR INSTRUCTORS OF PRINTING

R. RANDOLPH KARCH
Principal
High School of Graphic Arts and Printing
Cincinnati, Ohio
Now on leave of absence with the U. S. Navy

Refresh your teacher training with this quiz. Note down your answers, then check them against the answers which follow.

Instructions: The following questions are either true or false.

1. One who has a broad experience and good reputation in a trade need have no fear of his success as a teacher of that trade.

2. Vocational instructors need not perform operations skillfully when teaching their shop subject because the students, being unskilled, cannot tell the difference.

3. Work that students perform need not conform to objectives of the course, so long as the students are kept constructively busy on educational work.

4. Display of good work made in a shop is an incentive to the poorer students because it shows them what others in the same class can do.

5. The good work done on any project or job should be first called to the attention of the student, and any corrective suggestions should follow.

6. It is the responsibility of the instructor to make, buy or otherwise procure any instructional aids.

7. The effective demonstration is one which is as long and as comprehensive as the day will permit.

8. Films of all types are good instructional devices because they take the teaching out of the hands of the instructor, and do the job for him.

9. The main purpose of tests is to give marks to the students.

10. Trade standards are built on what the journeyman needs to be able to do and know, and the time it takes him to do the job.

Instructions: Select the best response in the following statements.

11. When calling upon students, it is best to
   a) Indicate selection by pointing or nodding.
   b) Give them a number and use it.
   c) Call them by name.

12. A student asks you a question which you have discussed a few moments before to the class. You should
   a) Correct him for not paying attention.
   b) Tell him to pay better attention; that the point was covered earlier.
   c) Ignore the question.
   d) Answer him, and explain that the point was covered.

13. A student asks a question on the subject taught, and you do not know the answer. You should
   a) Tell him you will explain it in a future lesson.
   b) Tell him that you are busy and will answer him tomorrow.
   c) Tell him that you do not know, but will look up the answer for him.

14. A student comes to your class carrying with him a reputation as a troublemaker. You
   a) Make no comment on the fact.
   b) Tell him that his reputation is known, and that he will be watched.
   c) Warn him that he will encounter difficulty if he does not mend his ways.

15. Discipline means
   a) Chastisement for mistakes.
   b) Making the students keep quiet.
   c) An improvement of attitudes and actions.
   d) Making the students afraid to do wrong.

Answers

1. False. A good instructor knows not only his trade or profession, but also knows how to *teach*. The two necessities are not always found in one individual. One's good reputation as a *worker* will not necessarily mean that he can also be successful as a *teacher* of that work.

2. False. Operations taught must always be performed skillfully. You can't fool the students!

3. False. All work performed must conform to objectives, whether or not the students are "constructively busy." Aims of the course must be followed.

4. True. Students should be cognizant of the good work performed by their contemporaries. "If *he* can do it," says Johnny, "then *I* can, too!"

5. True. The student has tried his best, and should not have disparaging remarks made of his work when he proudly shows it to his instructor. Compliment him on the good points of the work — then make corrective remarks and suggestions.

6. True. Supervisors and principals are too busy with other work to plan the lesson's needs of instructional material.

7. False. Usually, a long and quite comprehensive demonstration is too much for young minds to grasp. It should be broken up into its elements, and each step explained. Watch the fatigue factor during demonstrations!

8. False. Films are only instructional devices; they are only an *aid* to the instructor; they do not do the teaching job for him.

9. False. The main purposes of tests are to see if the learning and teaching is good. Making out marks for students is secondary.

10. True. Objectives (in vocational education) are to teach a trade; therefore standards should be built on standards of the tradesmen's abilities.

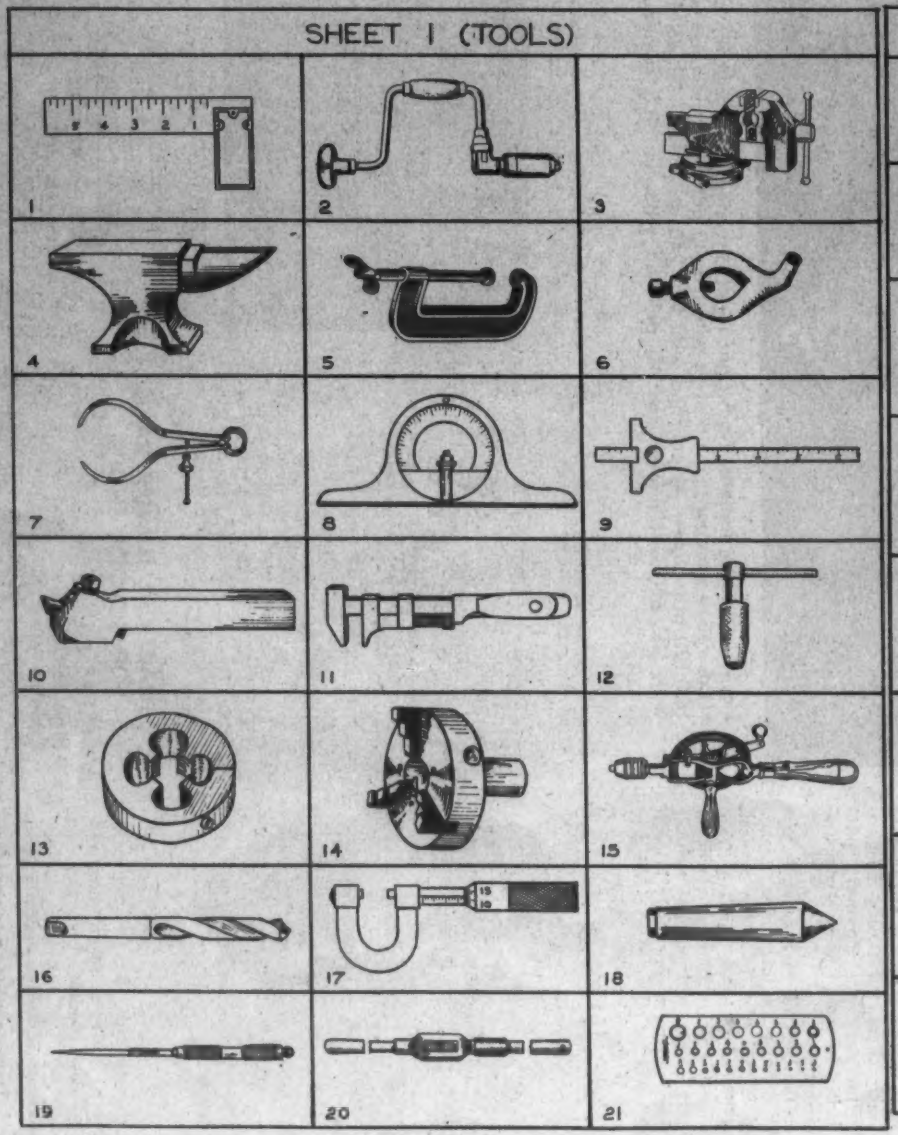
11. C is correct — call the student by name. If classes are large and have infrequent hours, help yourself to learn names by using a seating chart.

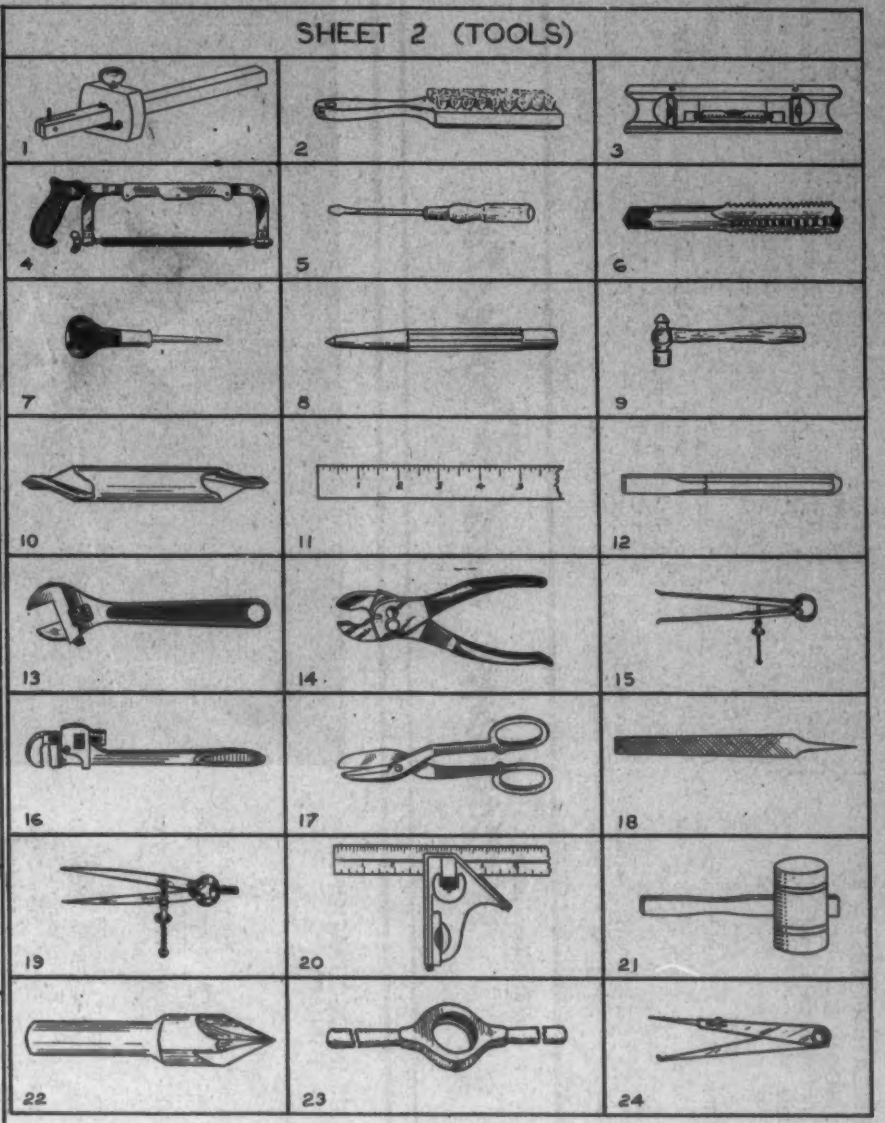
12. D is correct. He will be corrected when you state that the point was covered. He may have been in profound thought when the answer was given — he may *not* have been daydreaming!

13. C is correct. You do not lose face when you do not know all answers to a subject. How *could* you know? Remember — you can't fool the students!

14. A is correct — you make no comment on the fact. Don't allow one's reputation to militate against him — let the student escape from his past. Don't remind him that he is a "bad boy." Let him start afresh with the others, and not with a handicap.

(Continued on page 66)





Identification test by Samuel L. Bloom, Walker Junior High School, Milwaukee, Wis. For key see next page

IDENTIFICATION TEST — KEY

SAMUEL L. BLOOM
Walker Junior High School
Milwaukee, Wis.

(See test on previous page)

Sheet No. 1

1. Try square
2. Brace
3. Vise
4. Anvil
5. C clamp
6. Lathe dog
7. Outside caliper
8. Protractor
9. Depth gauge
10. Toolholder
11. Monkey wrench
12. T-tap wrench
13. Die
14. Chuck
15. Hand drill
16. Drill
17. Micrometer
18. Lathe center
19. Scriber
20. Tap wrench
21. Drill gauge

Sheet No. 2

1. Marking gauge
2. File brush
3. Level
4. Hack saw
5. Screw driver
6. Tap
7. Scratch awl
8. Center punch
9. Ball-peen hammer
10. Center drill
11. Scale
12. Cold chisel
13. Adjustable wrench
14. Slip-joint pliers
15. Inside calipers
16. Pipe wrench
17. Tin snips
18. File
19. Dividers
20. Combination
21. Mallet
22. Countersink
23. Die stock
24. Hermaphrodite caliper

QUIZ FOR INSTRUCTORS OF PRINTING

(Continued from page 64)

15. C is correct. Discipline is not punishment, it is the correction of attitudes and actions.

Problems and Projects

PLASTICS IN OCCUPATIONAL THERAPY

W. BARNES
Whittier, Calif.

The demands that the war has placed upon the occupational therapy divisions of our hospitals have been steadily increasing. The progressive O.T. instructors, therefore, have to be alert to keep abreast of new developments in the field.

One of the major problems has been to develop a project which will both stimulate and hold the interest of the patients, especially those who are bedfast. It follows, then, that any such project must be arranged to appeal to their latent talents and imaginations. The processes are, however, automatically limited to operations of a comparatively simple nature.

It was on the basis of these demands that one of the firms manufacturing plastic products developed the following project. Briefly, the procedure is to take a roughed out Lucite heart, crucifix, four-leaf clover, or any small art object, and polish it with a series of abrasive papers and finally bring it to the final luster by either hand rubbing or polishing with a special polishing compound.

The rough-shaped pieces are produced rapidly and cheaply by means of a special kick-press procedure; however, they can also be produced in the hospital by those patients who are capable of using small scroll saws. The abrasive papers recommended for use are the open-coat, silicon-carbide type. The best series of paper grits to use is as follows: (1) grit No. 80; (2) grit No. 120; (3) grit No. 240; and (4) grit No. 600.

Fig. 1. Lucite ornament. From right to left the steps in production are: (1) as rough stamped; (2) polished with No. 80 paper; (3) polished with No. 120 grit paper; (4) polished with No. 240 grit paper; (5) polished with No. 600 grit paper; and (6) polished with finishing compound

After using the 600-grit paper, the pieces can be brought to the final, clear luster simply by rubbing between the fingers or by polishing with any of the special Lucite polishing compounds.

If it is desirable, the pieces can be dyed with one of the new water soluble dyes.

The advantages offered by this project are:

1. The work can be done readily by bed patients.
2. Even patients with little experience can derive a definite satisfaction from making the appealing objects.
3. Hand polishing the pieces is an excellent form of exercise for the hands and forearms.
4. This type of work may be considered as an introduction to a new and important field — the fabrication of plastic materials.

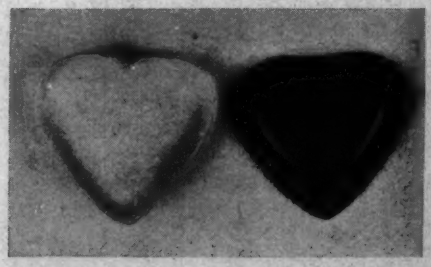
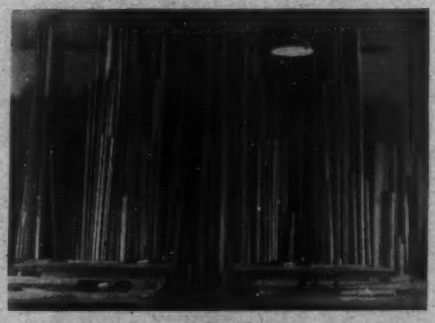


Fig. 2. Comparison of a finished and dyed piece with a rough-stamped piece

A PRACTICAL LUMBER RACK FOR SCHOOL SHOPS

LOUIS BAROCCI
High School
Cudahy, Wis.

The type of lumber rack illustrated and described herewith has been in use in our school for some six years and has many advantages that the old type of school lumber racks did not possess. Its chief advantage is that any piece of stock is instantly available without the necessity of shifting stock. It also has the other advantage that it requires far less space than the old conventional tier rack.

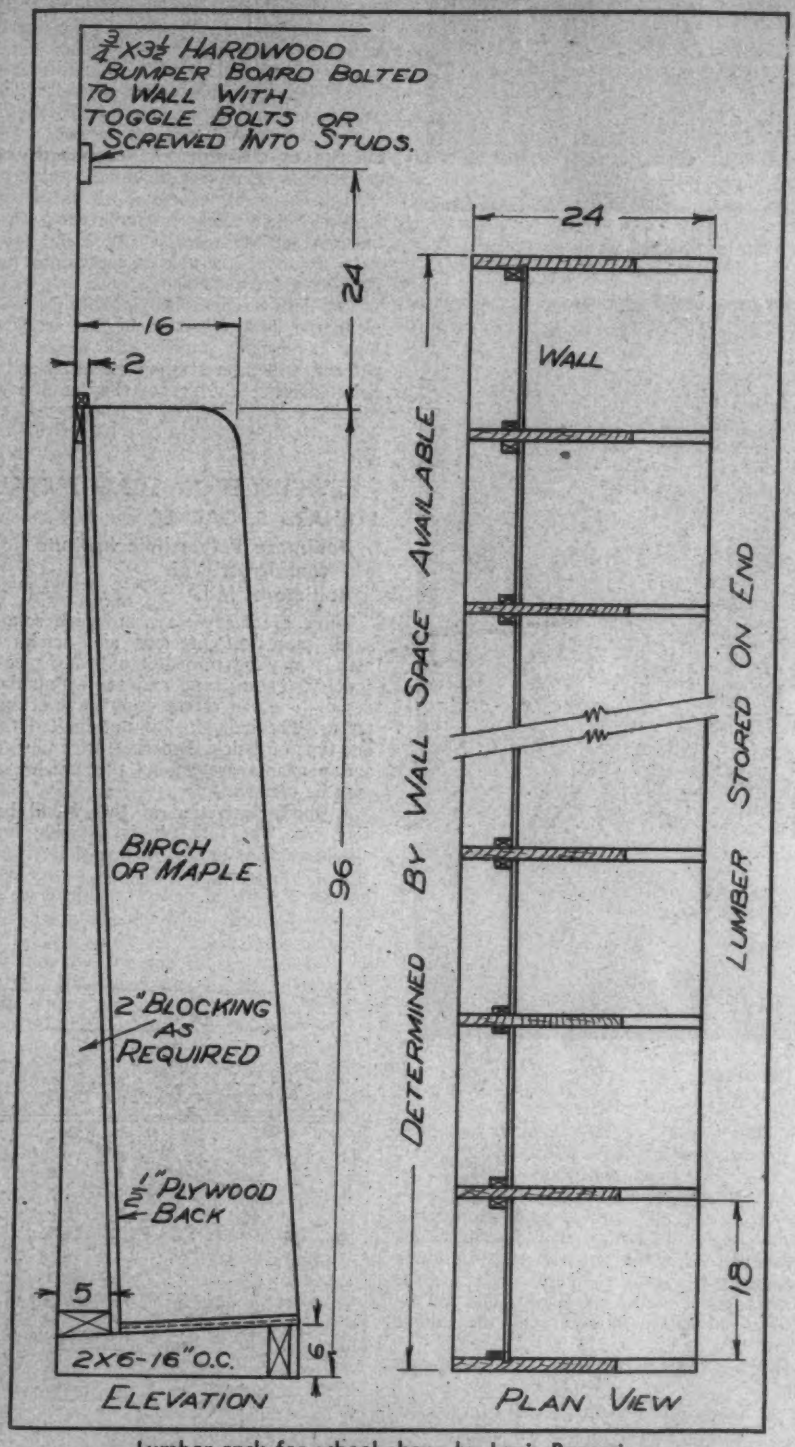


Practical lumber rack

The New York Survey and other surveys indicate that people who have received trade training in vocational schools make an average of 30 cents more per hour than those who have not had such training. — *R. H. Woods.*

RED CROSS WAR FUND

Though the roar of guns may cease, human needs remain. The Red Cross can meet these only with each one's continued generous support. The President has designated March as Red Cross Month, the period in which the 1945 Red Cross Fund will be raised.



Lumber rack for school shops by Louis Barocci

Red Cross activities are financed solely from voluntary contribution and gifts. All are urged to do their part in raising this fund.

PEACETIME READJUSTMENT OF WAR VETERANS AND WARWORKERS

Mr. Paul V. McNutt, chairman of the War Manpower Commission, in a recent statement, points out that the readjustment of war veterans and warworkers during the reconversion from wartime to peacetime production will be facilitated by the results of ten years of research by the Division of Occupational Analysis of the War Manpower Commission.

The Division of Occupational Analysis, now a part of the Bureau of Manpower Utilization of WMC, has made studies of more than 100,000 jobs and has prepared a series of manuals and publications dealing with "job science."

Employers, schools, and colleges, as well as the U. S. Employment Service, will have available numerous techniques which have been developed for the placement and guidance of workers. A new publication, "Physical Demands Analysis and Physical Capacities Appraisal Manual," will help determine what postwar job applicants can do on the basis of physical abilities. It will be found useful in placement work in the care of disabled veterans of the war.

POSTWAR OPEN HOUSE

N. H. POOLE

Emmerich Manual Training High School

Indianapolis, Ind.

For the past several years it was important that high school shops devote all their energies and resources to defense training, war production training, airplane model building, Red Cross project building, and part-time (schoolwork) programs. With such pressing demands as these it was necessary for many schools to dispense with open house, parents' night, and public or visitors' night. Now that the "hump" has been reached in war training the school shop should begin again to lay plans for interesting the public in its activities and accomplishments. One of the best methods of attaining this is by holding open house.

Open house formerly was held in the spring. However, for schools operating on the semester plan it might prove valuable to have an exhibit at the close of each semester. This will serve to bring different groups of patrons into the school and will also draw the attention of the rest to the school.

Some teachers consider open house as "just another job," for it does require a great deal of extra work, but school administrators, supervisors, and alert teachers consider it as an opportunity to:

1. Show the quality, variety, and quantity of instruction.
2. Encourage better work on the part of pupils.
3. Advertise the school.
4. Help with freshmen orientation and later scheduling.

The successful shop teacher begins to plan the exhibit early in the term. Projects selected by students are grouped as lawn and garden projects, novelties, porch furnishings, household furnishings, furniture, garage and shop equipment, toys, and sporting equipment. By so grouping, the teacher can plan early in the term, for placing the projects, for the space required, for any special hangers or wiring, for panels, for booths that have to be built, or for the purchase of special articles.

The logical place to hold the exhibit is in the shop where the projects are built. In this way the visitors see the room and equipment where the student works. Other places that can be used are the school halls, gym, auditorium stage, or a vacant, downtown storeroom.

Figure 1 shows a part of an exhibit that was placed at one side of a school shop.

Every student should exhibit some project. To encourage this a name tag and the name of the builder can be attached to each project. Novelty projects should be labeled and something that suggests the use of the novelty should be shown with it.

Small articles should be fastened down so that they will not be lost or stolen. Student guards and guides posted about the room

Fig. 1. Exhibit occupying one side of school shop

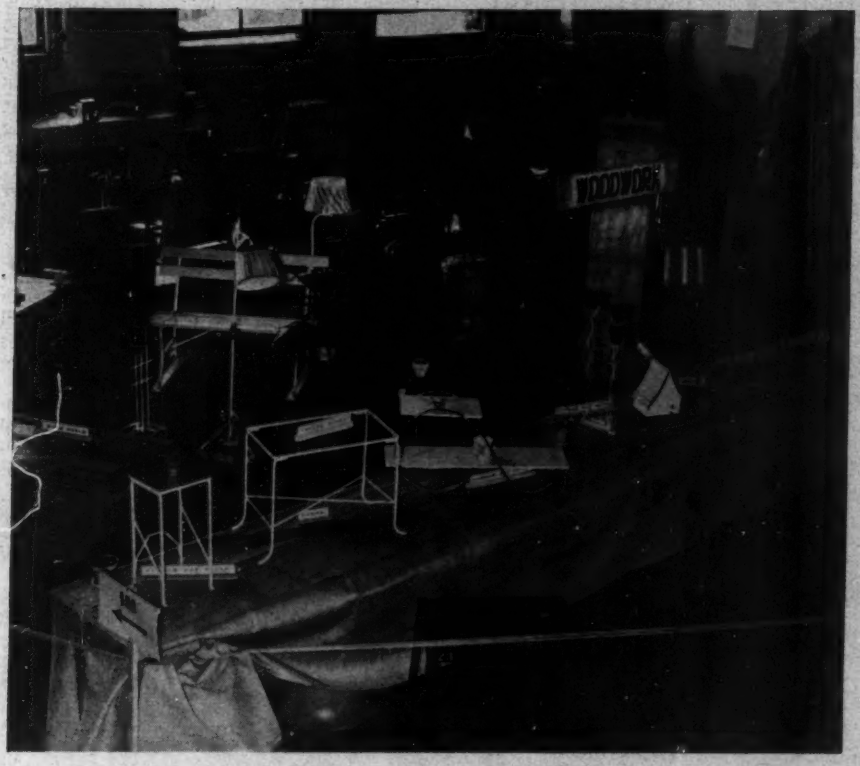


Fig. 2. Roped off area

can do much to prevent loss of articles. Certain areas of the exhibit should be roped off and visitors should be moved in one direction. Figure 2 shows how an area in a forge shop was roped off and traffic directed by the arrow on the standard at the entrance to the room.

The best time to hold an exhibit is Thursday evening, all day Friday, and Friday evening. If the shop is used for the exhibit, classes on these days can do sketching, have review, take a test on related work, attend a lecture or an auditorium program. The school paper, posters, students, and hand bills can be used to advertise the dates and hours. A general letter signed by the principal inviting all parents to come to the exhibit and meet the teacher or teachers is helpful.

If the room has a blackboard, have one of the students print in large letters WELCOME TO THE ——— SHOP. Another sign close to the exit door might read THANKS, COME AGAIN. The room and windows should be clean, temperature about normal, clean charts on the walls, and only completed projects should be shown. Lamps should have shades and be lighted, flower pots should be in flower pot stands, as shown in Figure 2. Flood lights, crepe paper, booths, and large plants can be used to advantage in decorating the exhibit area.

Other helpful suggestions for open house are:

1. Keep tall objects in the background.
2. Balance colors of painted objects.
3. Have small and most elementary projects exhibited near the entrance to the room.
4. Exhibit related materials together as a window flower box and a sprinkling can, but do not place a cement lawn roller next to a magazine basket.
5. Move traffic in one direction.
6. Label projects as to name and name of the builder.
7. Use natural or artificial flowers and vines.
8. Have shop-built machinery well guarded with safety guards, and running at a very slow speed.
9. Cover bench tops with brown paper, burlap, or black cloth.
10. Mount small work on panels. A panel made of ¼ in. by 4 ft. by 6 ft. plywood, with a molding around, and stained makes a nice appearance.
11. The appearance of forged and cast iron objects, which are unattractive to the eye, can be made attractive by adding a stripe or trim to the project using a bright red, green, blue enamel or aluminum paint.
12. Arrange the projects so as to avoid features which might produce crowds in any one part of the room.
13. Have photograph of the exhibit taken for the school records.

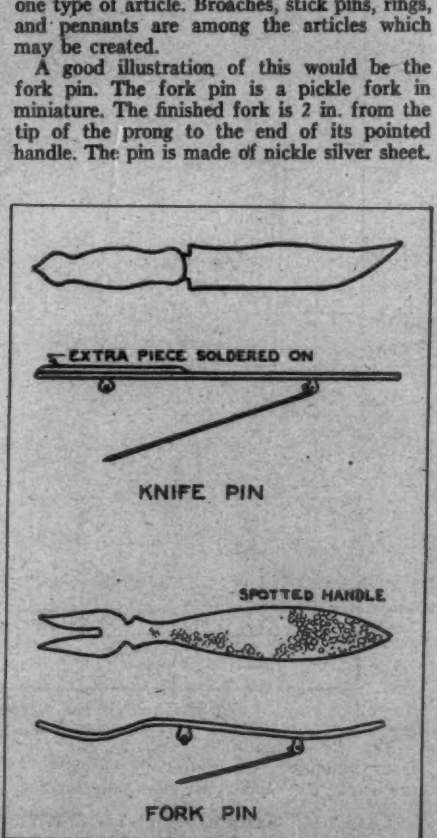
The shop teacher who plans for his exhibit along the lines suggested in this article will have a display which will please school patrons, will interest shop students, and will help advertise the school shop in the community.

JEWELRY FROM SCRAP METALS

BERNARD S. GARNER
Baltimore Polytechnic Institute
Metalcraft Club
Baltimore, Md.

There are many ways in which scraps or small pieces of precious and semiprecious metals may be turned into lovely pieces of jewelry. There is no end to the number of designs one can create using these scrap materials. The individual is not limited to any one type of article. Broaches, stick pins, rings, and pennants are among the articles which may be created.

A good illustration of this would be the fork pin. The fork pin is a pickle fork in miniature. The finished fork is 2 in. from the tip of the prong to the end of its pointed handle. The pin is made of nickle silver sheet.



Knife and fork pins

The pin also may be constructed of copper, brass, sterling silver, or gold. Aluminum is not advisable to use. Due to its rapid oxidation, hard solder or soft solder will not adhere to this latter metal.

After the material has been selected the pattern is transferred to it. Using a jeweler's saw cut the fork from the metal. The rough edges created by the saw should be removed by filing with a half round needle file. While the fork is still in sheet form, remove all scratches from both sides — with an emery stick. The emery stick is a narrow board about which is wrapped a sheet of fine emery cloth or paper. The fork is placed on the flat surface of the stick and is rubbed back and forth until all the scratches have been removed. On a flat top stake, using a 2-oz ball-peen hammer, spot the handle of the fork. A pleasing effect may be obtained by hammering around the edge of the handle. Using a rounded stake and a mallet if necessary, form up the handle of the fork to the desired shape.

The project is then ready to have the joint and catch soldered to the back of it. The job may be done with hard or soft solder, but it is best to use hard solder. Hard solder is silver solder. There are two types of flux available for hard soldering; borax and green flux. The green flux is a type of commercial liquid flux and does not swell like borax when heated. Place the fork upside down on a block of charcoal for soldering. The joint and catch may be bought from a jeweler. The joint or hinge is always placed to the right of the catch. With a pair of tweezers pick up the joint and touch the bottom of it to a drop of flux, then place it on the fork. A piece of solder the size of a pinhead and very thin is dipped in flux and placed beside the joint. Be sure that the flux around the solder unites with the flux around the base of the joint. The same procedure is repeated with the catch. After the joint and catch are set in position, apply heat with a blow pipe. The heat should be applied slowly until the flux dries. Then direct the main portion of the heat to the fork. After the fork has been heated to the melting point of the solder, and the solder begins to flow on its surface, direct the heat on the joint. When the solder flows to the joint it may turn slightly; this may be straightened by turning with a scratch awl while the solder is molten. Allow the fork to cool a minute or two, then drop it in a pickling pan of dilute sulphuric acid.

The project may be finished according to the maker's taste. It may be polished with rouge for a natural finish or it may be plated with green, yellow, rose gold, or sterling silver. The fork may also be finished by oxidation but this, of course, is limited strictly to the type of metal used for the project. The pin stem should be attached before plating; otherwise after polishing.

A good companion of this pin is the knife pin. It is also constructed from small pieces of metal. The method of construction is fundamentally the same as that of the fork. However, in making the handle a different method of procedure must be followed. In order to obtain the appearance of a regular knife, the handle must be built up with an additional piece of metal. The silhouette of the knife is cut from the metal; then the additional piece slightly larger than the handle but identical in design is cut. The extra piece of material is appliqued to the front side of the handle with hard solder. The pin is then turned over and the joint and catch soldered on. Finally the handle is rounded by filing after which the entire pin is ready to be finished.

BAND-IRON RACK

GEORGE WELCH
High School
Corfu, N. Y.

The band-iron rack shown herewith works very successfully in my shop. Some of the advantages of this rack are:

1. It solves the problem of short pieces — even though they are less than 12 in. long they may be piled on top of other strips.
2. This rack keeps the different kinds of metal separated. On my rack each partition holds 2 or 3 sizes of similar stock.
3. All metal is readily accessible — this is a great advantage over the type of rack where the metal must be pulled out at one end.
4. The rack always looks neat and orderly with a minimum of attention.
5. Even though placed in front of a window very little of the light is blocked out.

Our farm woodlands alone have a larger area than the combined forests of Norway, Sweden, Finland, and Italy. — *American Forest Products Industries, Inc.*

THE MATCHBOX HOLDER

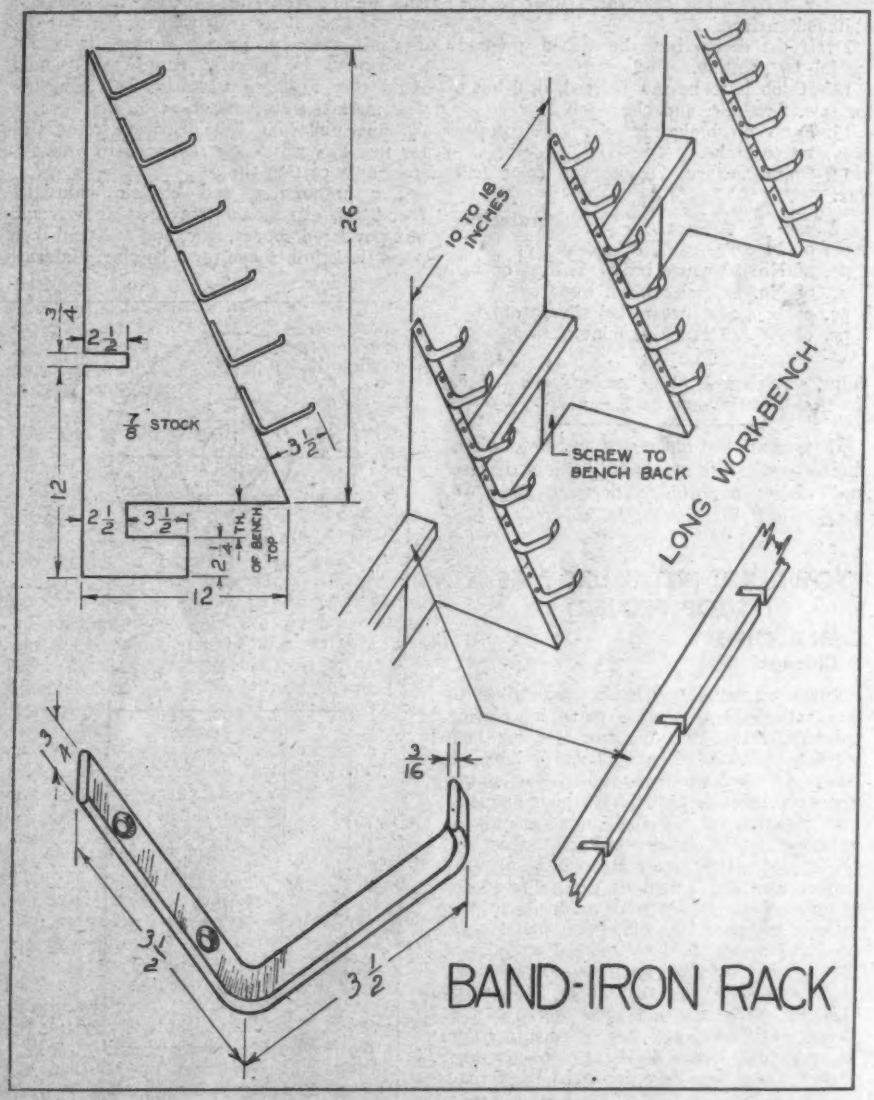
E. LE ROY LONGLEY
Baltimore Polytechnic Institute
Baltimore, Md.

The project described herewith presents an interesting introduction to art metal work. It may be used for groups of various ages and yet obtain encouraging results. These results will be because of the different materials and of different methods of ornamenting. The job sheet lists the materials usually used although if an especially good job is desired, and the cost is not to be considered, silver may be used.

These match safes may be decorated by saw piercing a design, by sawing out a design and soldering on, by soldering on an already stamped out design, by etching or by simple repoussé. These methods allow the student to express his ideas and desires and also give him the opportunity of utilizing a variety of different types of discarded materials for use in making useful objects.

Method of Procedure

1. Lay out the piece of metal to size.
2. Cut to shape with shear or snips.



Band-iron rack by George Welch

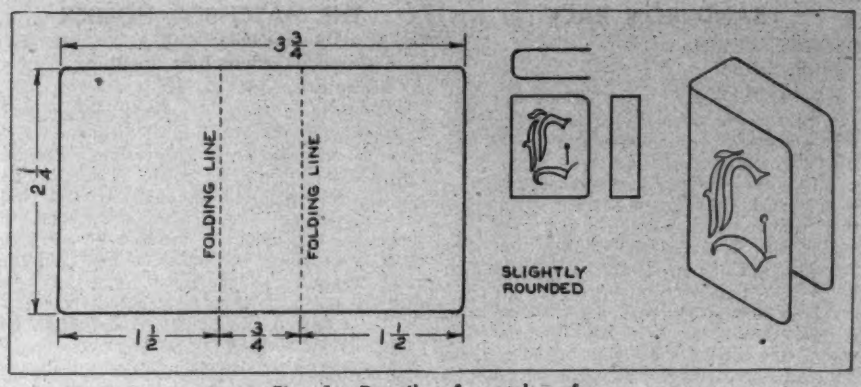


Fig. 1. Details of match safe

3. Flatten (if necessary) with mallet.
4. Clean with steel wool or on buffer.
5. Spot with suitable hammer.
6. Flatten on wood block with mallet.
7. Square and cut to exact size.
8. File edges and corners.
9. Mark folding lines as shown.
10. If design or initial is to be put on job, transfer it by means of carbon paper to the whitened surface.
11. If the design is to be etched, prepare the job by painting.
12. If job is to be saw pierced, drill holes for saw. Saw, file, and clean job.
13. Form on brake, in vise (use copper jaws) or on stake.
14. Clean surface, lacquer, or color and wax.

Materials

1 pc. of 24 or 32-oz. C.R. copper; or
1 pc. of No. 20 gauge brass (H.H.); or
1 pc. of No. 22 gauge black iron; or
1 pc. of No. 20 gauge nickel silver; or
1 pc. of No. 20 gauge aluminum

Tools

Snips, scratch awl, files, jeweler's saw frame, No. 2 saw blade, spotting hammer.

If trees are not harvested and used when their growth rate starts to decline, disease and decay eventually destroy them.— *American Forest Products Industries, Inc.*

POWDERED METALLURGY AS A SHOP PROJECT

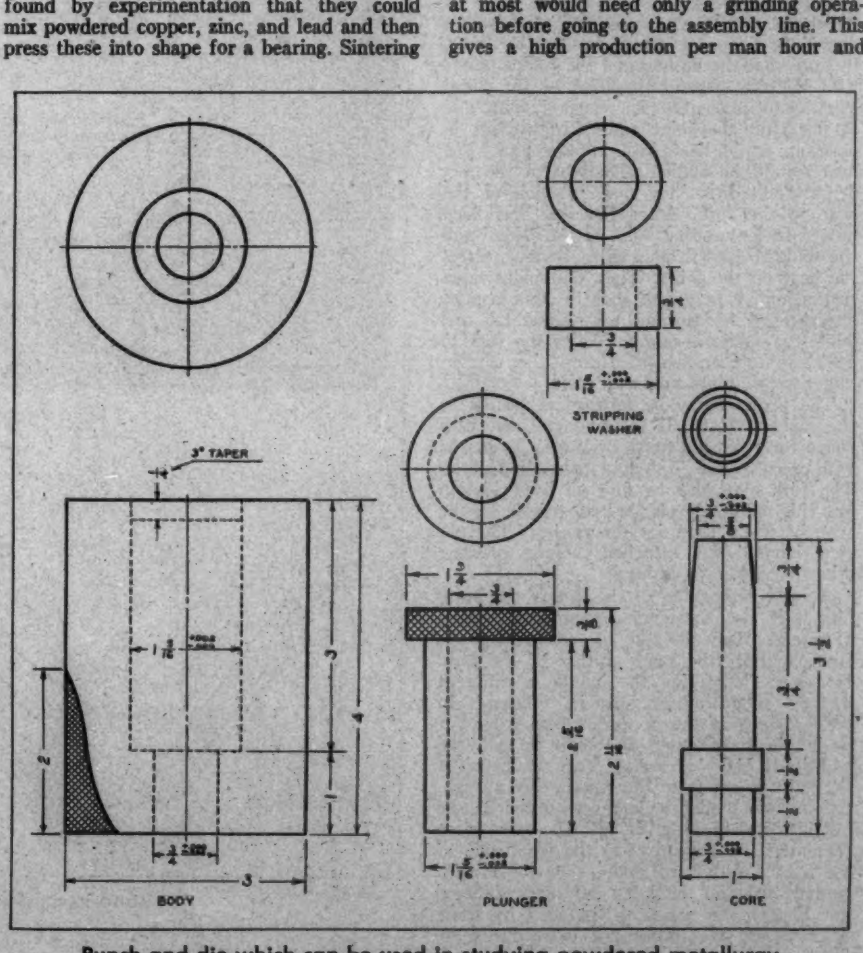
GLEN B. CHRISTY
Chicago, Ill.

Powdered metallurgy is the name given to the method of producing parts by placing powdered metal in a die and applying high pressure to the plunger. This produces a billet of metal which is rather fragile, but when the billet is heated to a high temperature it takes on all the characteristics of solid metal. The density of this product depends upon the pressure applied and the temperature and length of time allowed for sintering. The metal parts produced in this manner compare favorably with metal parts produced by standard commercial methods of like density in tensile strength.

Some writers say that there is evidence that ancient people did some work in powdered metallurgy, but there seems to be no accurate information available as to just what they did nor how they processed their materials. The beginning of our powdered metallurgy began when Dr. W. G. Coolidge of General Electric reduced tungsten oxide in a hydrogen atmosphere to obtain tungsten powder. He pressed this powder into bars which were too fragile to use. After sintering these bars at 1300 deg. C. he found that they were strong enough to handle. Later these bars were sintered at a higher temperature, and swedged. Next they were drawn through dies into fine wire. He was working to obtain a filament for electric lamps that would stand very high temperatures. This tungsten wire marked an advancement in incandescent lighting. Following this discovery came tips for tool bits which are cemented to ordinary steel as a cutting tip.

The automotive and electric industries found by experimentation that they could mix powdered copper, zinc, and lead and then press these into shape for a bearing. Sintering this part caused it to take on the characteristics of the alloy, and they had an oilless bearing. They also found that by varying the pressure and length of time for sintering on the iron, the metal was porous and would absorb oil. In this manner they had bearings which would stand up under light duty high speed without oiling. Light pressures and low sintering temperatures give a material of low density and quite porous which would absorb a large quantity of oil. This material is low in tensile strength but bearing materials do not need to have high tensile strength and consequently such material made ideal bearings.

World War II gave a demand for large quantities of materials far above the normal production figures. Methods of increasing man-power production were sought, and powdered metallurgy was developed rapidly. Experiments proved that powdered metal pressed under pressures of 70 tons and sintered at high temperatures would produce a ferrous metal with a density of 7.3 which is a satisfactory commercial density. Correct proportions of powdered iron, graphite, and nickel can be mixed together, pressed, and sintered, thus producing a very good quality of steel. Small parts formerly made in the foundry are now made by this process. Automatic presses can turn out very cheaply small parts by the thousands by this process, which are stronger than the same parts formerly made in the foundry. When these parts are taken directly from the sintering oven and coined they have increased density and can be held within tolerances of plus or minus .001 in. Such parts are ready for assembly or at most would need only a grinding operation before going to the assembly line. This gives a high production per man hour and



Punch and die which can be used in studying powdered metallurgy

reduces waste or scrap metal to a minimum. Small gears made by the machining method produce 25 to 30 per cent scrap and require many machine hours to produce. These same gears now produced by the pressed powder method have no scrap and there are no machine hours needed in their production, with the possible exception of grinding when they must be kept within close tolerances.

Powdered iron does not flow because under pressure it does not reach the plastic stage. Consequently the plunger must act in a straight line, or nearly so, on the powdered metal in order to secure an even density throughout the part. Because of this large parts have a tendency to have a greater density in that part next to the mold or plunger. This tendency has been minimized to some extent by pressing in a vacuum and by applying heat while under pressure. It still is true, however, that when the sintering temperature is low there is a varying density, and when the sintering temperature is high there is a problem of shrinking and warping.

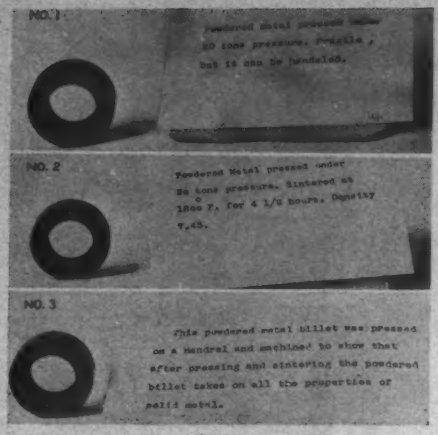
The high pressures used by this method of making metal parts causes great wear on the dies. These dies must be made out of the best die steel obtainable. The workmanship must be very accurate and naturally requires the services of the very best toolmakers. It is estimated that the simplest die made for this method of production will cost about $50. When only a few similar parts are desired the cost of the die would make this method prohibitive, but when several thousand parts are needed, the cost of the die becomes negligible in comparison with the man-machine hours cost necessary to manufacture them by standard methods.

In school shops quantity production of identical parts is not advisable, but instructors may familiarize their pupils with the method by the laboratory or demonstration method. A die of simple design can be made in the school shop which will answer this purpose. Since the die which is used in the school shop will be cleaned between each pressing operation, and is not submitted to the heavy wear of production methods, cold-rolled steel, case hardened, will make a very satisfactory die.

The die used in our shop produces a bushing. The boy is intrigued with the fact that a powder poured into a die, pressed and sintered comes out a solid metal the same as the other metal he works with in the shop. The boy has wondered why solid materials resist being broken. He has been told that all materials are made up of molecules and that the attraction of these molecules one for the other is that which gives the material its tensile strength. In this situation the boy actually presses a powder, sinters it, and makes a solid metal which he can machine as he does any other material. It also gives the boy a background nucleus of a manufacturing process with which he will come in more or less intimate contact in his future work.

The sintering process is heating the billet to a temperature of 1700 deg. F. or more at which temperature it is held for a certain period of time depending upon the desired density. For the purpose of the school shop 45 minutes to one hour is sufficient. The high pressure which is given the billet no doubt sets up stresses throughout the material and when the billet is raised to this high temperature the molecules become more active and arrange themselves into a more homogeneous mass and thereby give additional strength.

Oxidation is the great enemy of ferrous materials and sintering is carried on commercially in neutral atmospheres. In the school shops we can provide an atmosphere which has no oxygen. For this purpose our shop



Some of the tested samples

made an iron box 6 in. long, 3 in. wide, and 2 in. deep, which is used as a cover. Two or three billets are placed in the center part of a piece of flat ⅛-in. stock 2 in. wide and 5 in. long. On each end of this flat stock is laid a piece of wood ⅞ by 2 by 2 in. This piece of flat stock is laid on the floor of the furnace and the iron box placed over it as a cover. The wood absorbs the oxygen by burning and there is no oxidation of the iron. Small pieces of limestone can also be added to the wood under the cover as an added protection. This is a cumbersome process as compared to commercial methods, but the same results are obtained. Care should be taken that the wood does not come in contact with the billets or they will absorb carbon at the points of contact. Here the boy using materials with which he is familiar is able to produce an atmosphere practically free from oxygen, and no doubt gains a more fundamental concept of that metallurgical process than he would obtain from contact with commercial methods.

The density of wrought iron is given as 7.8 in most tables while the density of cast iron is given as 7.2. Mild steel is considered satisfactory when it has a density of 7.4. The metal parts made by the boys by the powdered metal process furnish them an opportunity to become familiar with the fact that the density of commercial produced metals is not constant, but may and does vary and yet is found acceptable when held within certain limits. The boys will weigh the metal which they have pressed and sintered, and then, in the usual manner, weigh it again immersed in water. With these figures they can easily figure the density of the particular metal which they have produced.

When two masses of a given material have a different density what does it mean? That is a natural question for the boys to ask. The next step then is for the boys to heat the metal they have made to drive off any moisture it may have absorbed. They must not heat the metal too hot or it will oxidize. When the metal has remained at about 700 deg. F. long enough to drive out all moisture that it may have absorbed, it is plunged into oil. When it is sufficiently cool to handle it is taken out and wiped quite dry. It is again weighed and any additional weight that it has acquired represents the oil it has absorbed.

When we performed the experiments with this material, we numbered each sample by stamping it with ⅛-in. steel stamps to identify one from another. The results shown in Table I show the findings on 14 samples.

From this table we can tabulate the following number of learning situations.

TABLE I. Tests on Articles Made by the Powdered Metal Process

No.	Tons Pressure	Sintering Hrs.	Sintering Temp. F.	Density	Oil Absorbed	Size of Powder	
			FINDINGS				
1.	10						The corner chipped off from this sample when it was removed from the die, which was evidence that the pressure was too low.
2.	20						This sample retained sharp corners when removed from the die and did not chip when handled carefully. When filed, the grains of metal came from the sample with the same appearance they had in the powdered state.
			SINTERING				
3.	20	1½	1800				The sintered sample was filed and showed the characteristic appearance of iron. When the surface was polished with emery cloth it took a high polish.
4.	20	1½	1800				A sintered sample was pressed on a mandrel and machined between centers on the lathe. It machined much like cast iron. The tensile strength was very low. Samples sintered for longer periods of time showed increased density and tensile strength. Sintering at a higher temperature also increased density and tensile strength.
5.	20	1	1800	6.15	.2	100	
6.	20	1½	1800	6.75	.2	100	
7.	20	1½	1800	6.95	.2	100	
8.	20	4½	2000	7.45	.1	150	
9.	20	4½	2000	7.3	.3	100	
10.	20	4½	2000	7.12	.2	150	
11.	20	4½	2000	7.35	.1	150	
12.	20	4½	2000	7.49	.2	150	
13.	20	4½	2000	7.3	.1	150	
14.	20	4½	2000	7.4	.15	150	

1. The sample pressed under 10 tons pressure chipped at the corners when it was removed from the die and broke easily when handled. This was evidence that a higher pressure must be used.

2. The sample pressed under 20 tons pressure retained its sharp corners, but when filed the grains of metal came from the sample of the same size and appearance as the original powder, leaving a rough surface. This showed that while the sample held its shape it was still only powdered metal pressed together.

3. The sample pressed at 20 tons and sintered at about 1800 deg. F. for one hour was filed and stoned to a polished surface. This showed that the sample had taken on the physical properties of solid metal.

4. The same sample was pressed on a mandrel, placed between centers, and turned

on the lathe as further proof that the physical properties of a solid were present. When laid on an anvil a light blow of the hammer broke it showing that it had little physical strength.

5. The boy establishes the density and the amount of oil which each of the samples 5 to 14 absorbed. From this he learns the technique of weighing samples, figuring results, and tabulating them.

6. From his tabulations the student deducts that a longer sintering time produces greater density. He also realizes that the densities are not uniform, and that the amount of oil absorbed is not uniform with the densities of his samples.

The pupil has established a background of knowledge in powdered metallurgy by going through these activities, which will enable him to read and understand articles written on this subject in trade magazines. The instructor should furnish the pupils with references to where such articles may be found so that the pupils may obtain further information in this field.

THE FUNDAMENTALS IN JUDGING A HOUSE

J. EDGAR RAY
The Stout Institute
Menomonie, Wis.

(Continued from page 27 of the January, 1945, issue)

Keep the home fires burning is just as true today as it was many years ago. Modern heating systems have solved the problem of heating and even temperatures, but there is nothing that equals the fireplace in making the room cozy and homelike. Around the fireplace or the fire as it was many centuries ago, your friends will find an inviting atmosphere that seems to open up the heart and stimulate all manner of happy thoughts, intimate confidences, and friendly discourse.

From the practical point of view the fireplace will have little effect on the winter's cold, but it is very welcome in the spring and fall. From every point of view, sentimental, aesthetic or practical, every house should have at least one good useful fireplace. Build your fireplace with this thought in mind; "I am going to use this accessory often — it shall be a friendly fire where cronies meet."

There are many designs available for a fireplace, but the following must be kept in mind: (1) The fireplace should be in scale with the size of the room; (2) The fireplace should be in harmony with the style of architecture used; (3) The fireplace should be built absolutely fireproof, with the purpose of being used often. There are several devices on the market which will aid in making the fireplace function perfectly, such as dampers, heatalators, and devices that assist in circulating the air, and getting the full value of the heat that is generated from the fire. Under no circumstances should the fireplace be connected with the flue of the furnace or any other flue where a fire is needed. Each fire in the house should have a separate flue. Figures 12 and 13 illustrate some desirable fireplaces, all of which may be built of stone, brick, or tile masonry. The size and shape of the fireplace opening should be in proportion to the whole unit and have a flue that will be sufficient for the combustion chamber. The hearth may be built also of any of the foregoing materials, projecting into the room at least two feet or wider. There are other fireplace accessories that complete the ideal combination such as grates, irons, firesets, screens, coal scuttle, mantels, and fireside benches.

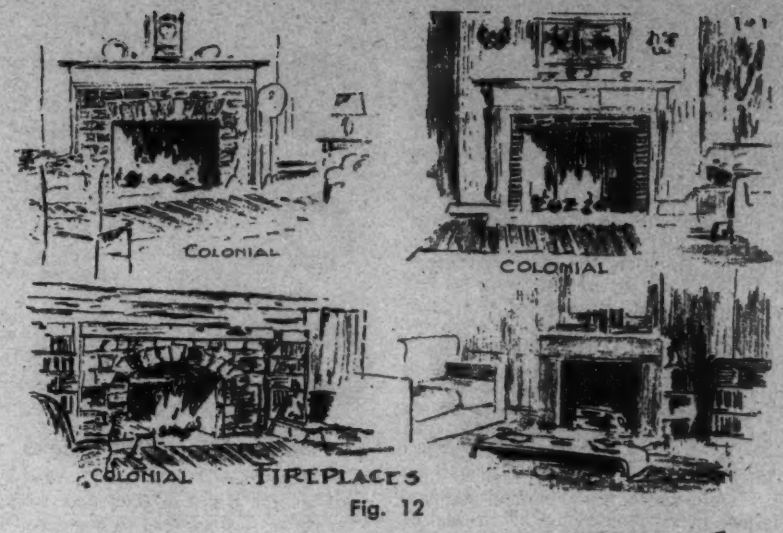


Fig. 12

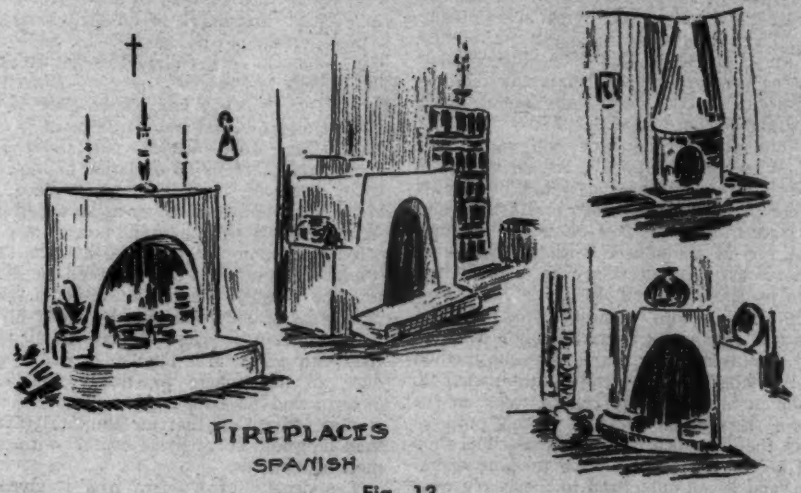


Fig. 13

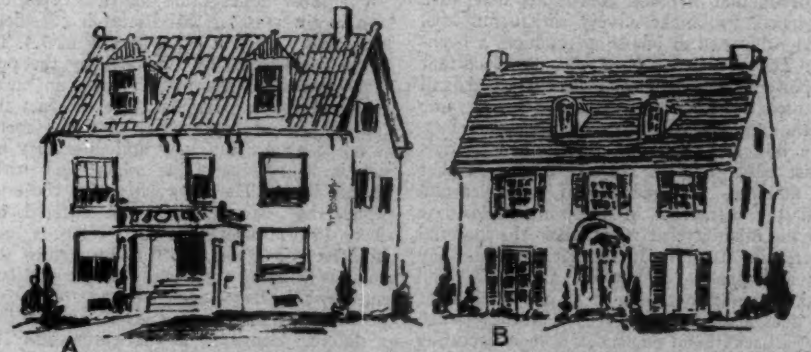


Fig. 14. Example of a poor design at A, and a good design at B

At this point the writer wishes to make it clearer to the reader just what is involved in determining what is good and poor design in exteriors, what are some of the fundamentals that go to make up a design whether it be poor or good. At A in Figure 14 is shown a poorly designed house. At B are shown changes that would make the house more pleasing in design. The reader's attention is called to the huge cottage type windows, in the design at A; also the huge and vulgar dormers; and especially the tile roof. The projecting of the eaves is out of place and the brackets are decidedly not in keeping with a good design. The cellar windows are very conspicuous and should have been placed in areaways below the grade of the house.

The steps to the entrance door do not help to make a restful appearance, and the first floor is entirely too high above the grade line. The front porch is very much out of scale with the type of entrance required, and with the house in general. The placing of the windows is poor, and the house as a whole does not come in the category of any architectural style. At B in Figure 14 is shown how the design at A could be remodeled to

be more pleasing to the eye. Note these points; it is lower in appearance, with the floor line just a little above the grade. The grouping of the windows is more thoughtful and they harmonize better. The dormers are smaller and inconspicuous and entirely in keeping with the whole design. The entrance is very much more appropriate and in scale with the front façade. The division of the windows with the shutters completes the design. An additional chimney has been added to the house thus giving a more symmetrical appearance. Note the smaller windows at the second floor level. Figures 15 and 16 will explain just what characteristics are involved in poor design and how to remedy them.

Figure 15 is sketched to show many details that are not usually found on the same house, although in some of the following sketches from actual photographs they are almost as flagrant in their many mistakes in designing.

At A in Figure 15 are two *open faced* windows, not divided, which are too large for that part of the triangle. A small window as shown in Figure 16 is the better answer. At B in Figure 15 is a boxed-like attempt to show a bay window with a peculiar slanting deck roof braced by some brackets. Needless to say, the whole unit is atrocious, and is neither necessary nor adds anything to the details of the house. A glance at Figure 16 shows a more consistant arrangement.

At C, Figure 15, are shown useless brackets supporting the wide overhang of the roof. The barge board finishing the projection of the roof is hideous. Note the practical cornice in Figure 16 and how it is returned with a pleasing projection.

At D, Figure 15, the porch roof which is wide and expensive, gives the appearance of sliding off. The porch detail in Figure 16 is more in keeping with good design. The lattice work softens what may have been stiff lines, and adds an interesting note to the detail.

E, in Figure 15 is supposed to be a bay window with another slipping roof and not having any foundation gives a feeling of not being finished nor structurally sound. A glance at Figure 16 shows how this bay window could be redesigned. The method of handling the roof is very commendable.

Figure 15, at F, shows a promiscuous use of brickwork which is entirely out of keeping with a frame house. The heavy capped wing walls are not necessary and give the feeling that they were put there to make an impressive appearance. A glance at Figure 16 shows wooden steps, which give a genuine appearance and are in keeping with the house in general.

At G, in Figure 15 is shown a band-like effect for which there is no definite reason, unless it was planned to indicate something to which might be hung the two small windows which flank the fireplace on each side. These windows at H would look better if they were made full-sized windows, well divided and flanked on each side by slatted shutters, as shown in Figure 16.

The porch at I in Figure 15 is not as good an arrangement as the open rail porch shown in Figure 16. Open porches eliminate the dark spots and dampness usually found in porches built up with huge unsightly brick walls. The battered and paneled column is unnecessarily large and the combination of brick, concrete caps, and wood complete the picture of *just what not to do*. Columns or piers should only be heavy enough to support the porch roof. The heavy porch columns found in some residences are just a waste of material and labor, and add nothing to the design. Note the delicate posts supporting the porch in Figure 16. They are ample and delightfully interesting. Figure 15, at K, shows an attempt to make a deck-like roof over the two *bumps* meant to be bay windows. At L, in Figure 15, are shown four little windows having no aesthetic value which are just four holes in the wall. A study of Figure 16 shows this detail properly executed.

Note the changes in windows in the correctly designed house, their interesting divisions of glass, and the general balance and grouping of the windows. In studying and comparing the two designs, it is very easy to see the effect of good designing when compared with poor designing.

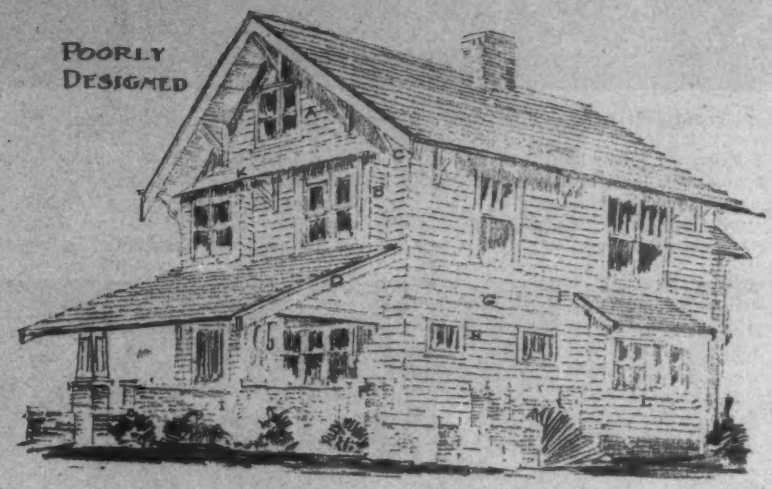


Fig. 15. A poorly designed house

Fig. 16. An improved version of the design shown in Fig. 15

AERONAUTICS IN INDUSTRIAL ARTS

STANLEY DRAZEK
Formerly at Liberty High School
Liberty, N. Y.
Now with the Army Air Force

Despite the fact that one of the important aims of industrial-arts education is to portray industry to the youth of the school, very few schools are offering courses in one of today's most important industries — aviation.

Until the fall of 1941, very few schools offered any courses in aeronautics. Today, with federal aid together with the financial aid given by some states, the number of aeronautic courses has increased slightly, but there are still far too few schools offering this important training.

Reasons for not including an aeronautics course in the industrial-arts shops are invariably given as follows:

1. The cost of equipment is too great.
2. Lack of a trained instructor.
3. Lack of floor space.
4. Difficulty in obtaining equipment and materials.

These objectives can be overcome by pointing out to the administrator or school board that:

1. (*a*) Inquiry should be made of the state supervisor of industrial arts to see if any state aid is given for fostering aviation courses.

(*b*) The Federal Government should be contacted for loans of equipment. (Much excellent aviation equipment has been issued to many schools.)

(*c*) If no assistance can be expected from the state or Federal Government, the school board could then make an appropriation of $200 to $500 for a small plane, engine, and instruments. A cracked up training plane can

From left to right: Making a wood rib; welding a fuselage; engine overhaul; magna fluxing a wrist pin

be purchased for much less than one in excellent condition. It will provide excellent experience for those working on it.

A small start will give impetus to the course and it will grow.

2. The lack of a trained instructor should not be a serious problem. The present industrial-arts instructor can prepare himself by studying at home, spending some time at a near-by airport, and by attending a summer course if need be.

Many ambitious instructors have gone through this type of processing, and their students, upon entering the armed forces, have spoken most highly of the high school aeronautics training they received.

3. It is true that many present industrial-arts shops are overcrowded. With the addition of new courses, new equipment has been added and many shops today could not be rearranged to accommodate a plane. However, many of the schools now offering aviation training were confronted with a similar problem and solved it by:

(*a*) Suspending the plane and wings from the ceiling in such a fashion that they may be lowered for the aeronautics class to work on. (Curious children cannot punch holes in the fabric and do other damage.)

(*b*) Placing the plane in a near-by vacated classroom.

4. No administrator or supervisor should deny a school the opportunity of offering an aviation course because materials and equipment are difficult to obtain. This is far from being true for there are more agencies today dealing in aviation supplies and equipment than ever before. Small planes, engines, parts, and supplies are advertised in practically every magazine.

Aviation will play a most important part in postwar plans. Since the purpose of education is to prepare the individual for his proper place in society, it is the responsibility of our schools to train their youth for this postwar world. Will our schools meet this challenge?

The illustrations show the wide variety of experiences opened to students in a well-organized course. They also show opportunities for correlation of many phases of industrial arts with aeronautics.

From left to right: The planning center; casting propeller blades; balancing propeller; adjusting the pitch of the propeller blade; retipping a propeller blade

From left to right: Building a propeller guard; wing repair; internal combustion engine; dismantling radial engine; building a gyroscope

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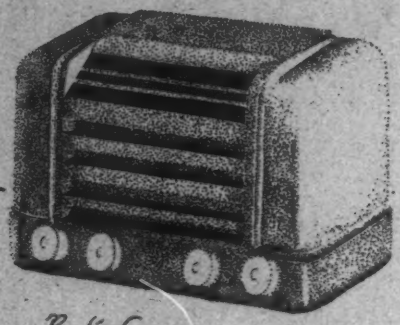
The brilliant record of our vocational schools in this global war is well known. But, when the war is over, this country will have in its lap some of the greatest industrial, social, and economic problems of all time. Here is where vocational education comes in. Education must change with our changing economy.—*R. H. Woods.*

WHAT ARE THE TYPES OF PLASTICS?

The industrial designer has at his disposal a long list of plastics whose properties are versatile enough to include almost any desired characteristic.

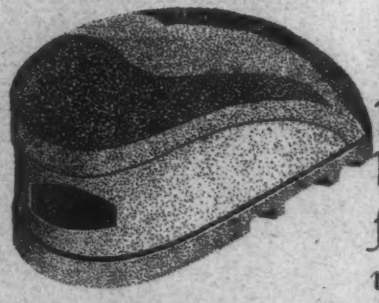


Radio Case

Major types are thermosetting, which become permanently set after molding, and thermoplastic, which can be softened by heating and reformed.

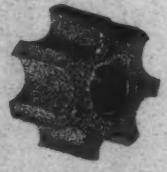
Forming is done principally by subjecting the raw material to high pressure in metal molds, with or without heat, or by pouring into lead molds, followed by baking. Aside from commercial products, completed in the molding, plastics reach the consumer in sheets, rods, tubes, laminated structures, or in novelty forms to be cut to size and finished by hand. Paints, and lacquers made from these materials are increasingly common.

Characteristics of different varieties range over a long list of qualities. Some are opaque, others translucent, or transparent. Black, white, or a hundred colors are available. Low or high dielectric strength, light fastness, resistance to acids, alkalis, solvents, or water, may be had. Fire and heat resistance, low thermal expansion, and freedom from taste are possible.



Sweeper Housing

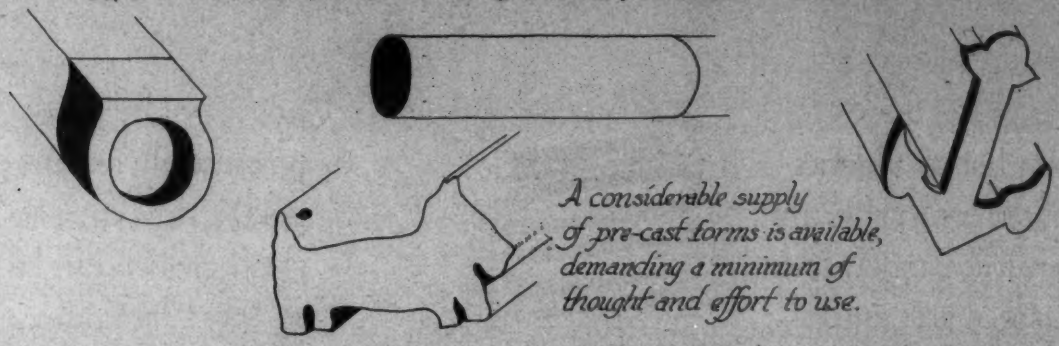
The designer of plastic articles often follows a "modern" streamlined style, partly because it is appropriate to do so, and partly because of the nature of the material and the molding process. Large surfaces are often broken up to obtain a better finish. Reeding, fluting, or other ornament cover "flow lines" on side opposite ribs. Fillets, rounds, and rounded corners add strength and are more easily molded, and more economically cleaned.



Laminated Gear

Plate 50. Design course by Burl N. Osburn, director of industrial arts, State Teachers College, Millersville, Pa.

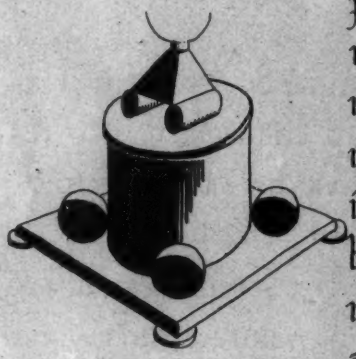
CAN THE HANDWORKER USE PLASTICS?



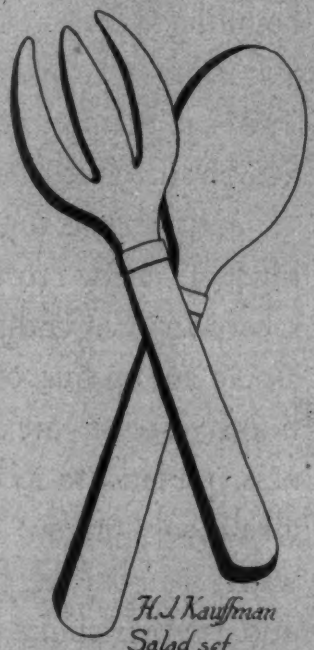
A considerable supply of pre-cast forms is available, demanding a minimum of thought and effort to use.

Products made by hand from standard plastic forms cannot, of course, be further processed by the basic methods by which plastic articles are manufactured, but must employ wood & metal-working processes. Until means are found for performing the basic plastic processes by hand these materials remain rather in the class of appendages or gadgets. The designer is restricted, therefore, to planning minor variations on standard forms.

Care must be exercised in built-up articles to avoid the effect of a juggling act.

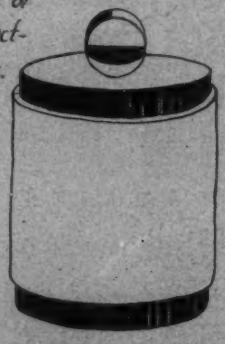


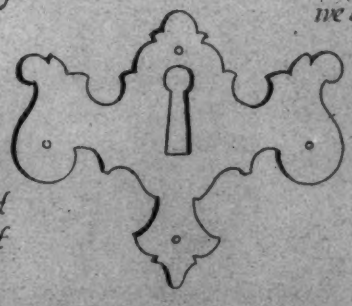
Plastics combine well with other materials.



H. J. Kauffman
Salad set
Transparent plastic with pewter

Black and white or two colors are effective in combination.





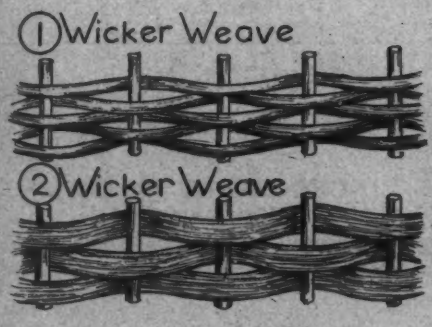
These two drawer pulls represent appropriate and anachronistic uses of plastics— an ever-present problem with an abundant new material.

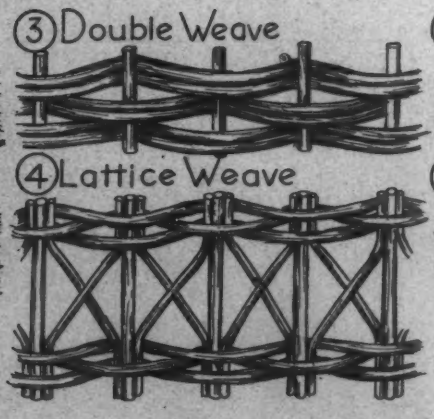
Plate 51. Continuation of design course by Burl N. Osburn, director of industrial arts, State Teachers College, Millersville, Pa.

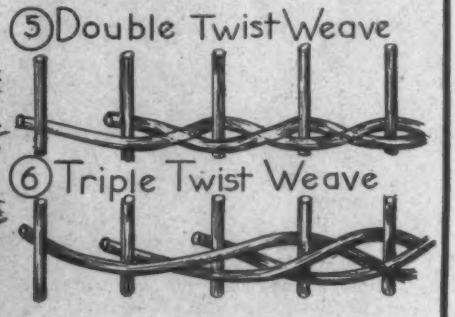
REED BASKETS

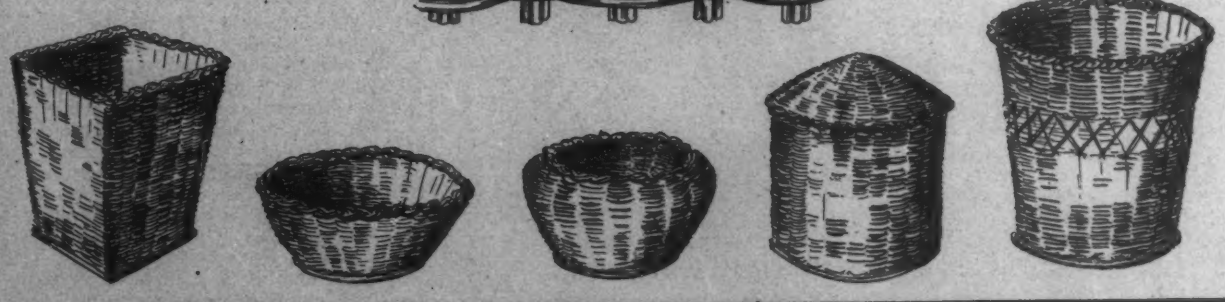
Letter Basket Cut 6" diameter circle from $\frac{3}{8}$" plywood for base. Cut 25 spokes of No. 4 reed 18" long and space evenly $\frac{3}{16}$" from edge. Begin double twist with No. 2 $\frac{1}{2}$ reed, weaving 4 rows. With flat reed weave 22 rows; end with 3 rows double twist. Finish with 3-strand braided edge.

Flower-Pot Holder Base is a 4 $\frac{1}{2}$" diameter circle cut from $\frac{3}{8}$" plywood. Cut 19 spokes of No. 4 reed 17" in length. Spokes are evenly spaced $\frac{3}{16}$" from edge. Use double twist with No. 2 $\frac{1}{2}$ reed to 6" height. Top is flared to 7" diameter. Finish with a 2-strand braided edge.









Basket designs submitted by Louis V. Newkirk, director of industrial arts, Chicago, Ill.

INSTRUCTION SHEET

LONNIE GILLILAND
Foster High School
Oklahoma City, Okla.

Job: Planning the job. The job is planned in order to save time and insure accuracy.

Equipment: (1) Project plan sheet; (2) pencil; (3) scrap paper; (4) price list.

I. Make a working drawing of the project selected and have it checked by the instructor. (See notes on blueprint reading.)

II. Make out a bill of material for the project. See bill of material form.

A. All dimensions should be taken from the working drawing.

1. When ordering lumber, the thickness, width, and length should be stated in the order mentioned.
2. List all pieces of the same size together.

Example: 4 legs 2 x 2 x 30 in.

B. Figure up the number of board feet* of lumber in each part of the project and add to get the total.

Example:

3 pc. — 1 x 12 x 24 in. = 6 board feet
2 pc. — 1 x 6 x 48 in. = 4 board feet
Total = 10 board feet

2. Formulas for figuring lumber.

a) $\frac{T \times W \times L}{144}$ used when the length of material is in inches

Example:

$\frac{1 \times 12 \times 48}{144} = \frac{4}{1}$ or 4 board feet

b) $\frac{T \times W \times L}{12}$ used when the length of material is in feet

C. Find cost of lumber.

1. Multiply total number board feet of lumber times price per board foot (see bulletin board for price list) to get cost of lumber. Example: 4 bd. ft. × 15c = 60c. Cost of lumber.

D. Figuring cost of finish.

1. Multiply the total cost of lumber by 30 per cent. Example: 30 × 60c cost of lumber = 18c cost of finish.

E. Other materials.

1. This includes sandpaper, hardware, and anything else that has not already been included.

F. Find total cost of project.

1. Add cost of lumber, cost of finish, cost of other materials = cost of project.

G. Job analysis.

1. List the steps to be followed in the construction of the project, such as designing, squaring stock, locating and boring holes, sandpapering, assembling, applying finish, and the like, on the back of the bill of materials.

Questions:

a) State briefly why a project should be planned.

b) What two things does a working drawing tell about an object?

c) What is the order for stating the dimensions of lumber?

d) What formula is used for figuring lumber when the length is inches?

e) How much is added to cost of lumber for finish?

*Any piece of lumber containing 144 cubic inches is equal to one board foot. Example: 1 x 6 x 24 in.

Bill of Material

School | Bench No. | Student's Name

Date | Period | Project

I. Working drawing. Draw the views that are needed to properly represent the project on the squares below.

II. Lumber Bill. Lumber is figured by the board foot.

No. of Pcs.	Description	Size TxWxL	Kind of Lumber	Bd.Ft.	Price	
						Cost of Lumber $ _____

III. Finish
Add 30% of Cost of Lbr. for Finish — Cost of Finish $

IV. Other Materials

Quantity	Item	Size	Kind	Price	Cost	
						Cost of Hardware $_____

Approved by — Total Cost of Project $_____

Instruction sheet by Lonnie Gilliland

Metal picture frame

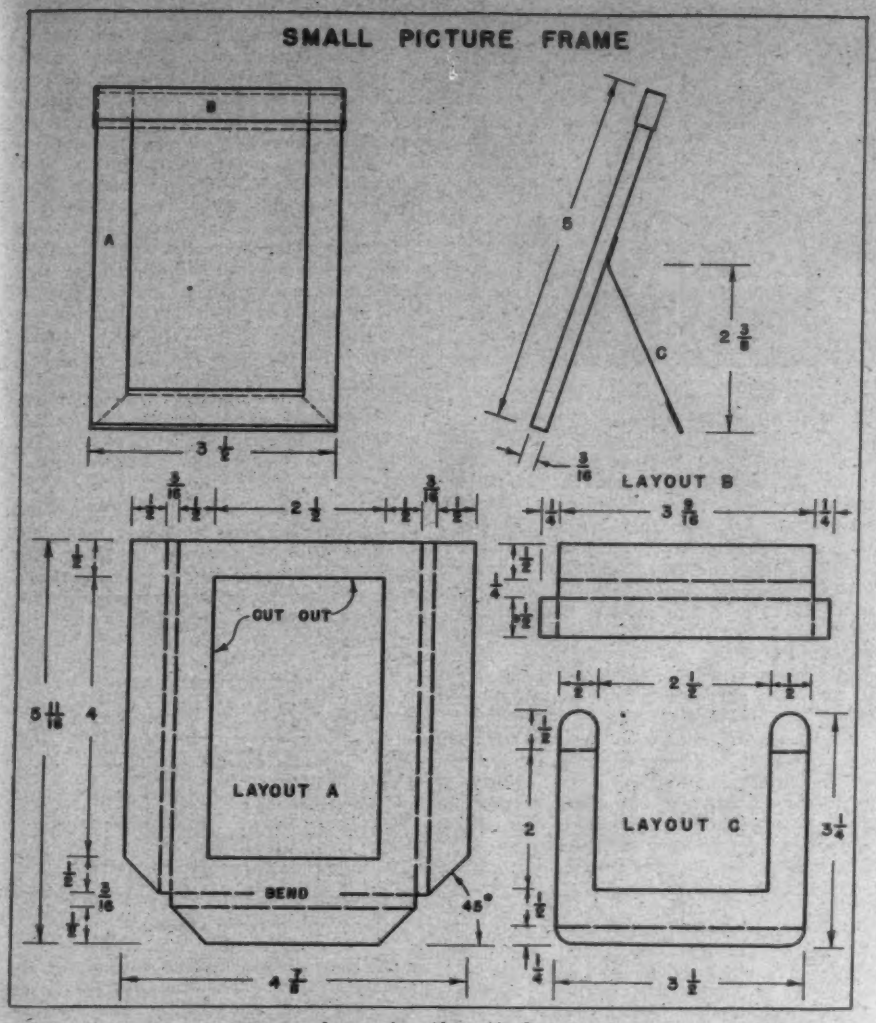
ORNAMENTAL TIN CRAFT

CHRIS H. GRONEMAN
Industrial Education Department
A. & M. College of Texas
College Station, Tex.

(Continued from page 28 of the January, 1945, issue)

Metal Picture Frame

The small picture frame described in this article accommodates a 3 by 5-in. photograph or print. It is of modern construction and the design is such that it will fit beautifully into the general decorative scheme of the desk set previously described. There is no particular ornamentation other than the closely peened surface which is finished by copperplating. All of the parts are of single thickness sheet tin, thereby making it extremely easy to cut, bend, and fit. It should be noted that the top, as shown at *B* in the illustration, is slightly larger than the main frame, making the picture and glass easily removable. After the pieces *A* and *B* have been cut and bent, the mitered and butt joints should be soldered so their shapes will be retained indefinitely.



Picture frame by Chris H. Groneman

The opening for the picture may be cut with a sharp cold chisel on a lead block or cut with the jeweler's saw frame and blade, after which it should be filed and dressed with emery cloth. If care is exercised, an ordinary jig saw and coping saw blade may be used to cut the opening if the sheet tin is fastened between two pieces of ¼-in. 3-ply scrap stock. The bend of the main frame may be made over the edge of thin presdwood while the forming of the top piece can be done over the edge of ¼-in. plywood. The hem on the bottom of the stand *C* can be made over the edge of a bench, with hand folders, or on a bar folder.

If the craftsman wishes to alter the size of the frame to fit other size pictures, the proportions of the borders on the frame will have to be changed accordingly to retain proper design.

Bill of Materials

No. of pieces	*Item*	*Size*
1	Sheet tin *A*	5 x 6
1	Sheet tin *B*	1½ x 4⅜
1	Sheet tin *C*	3½ x 3½
1	Glass, single strength	3¼ x 4¾
	Solder, flux, steel wool	

Tools

Copperplating setup, emery cloth, file, heating device, jig or jeweler's saw frame and blade, lead or wood block, peening hammer, rule, scriber, soldering copper, tin snips, and wood pieces for bending.

Procedure

1. Lay out design as shown in illustration, or develop original design.
2. Cut out tin stock for all parts.
3. Mark and cut out photograph opening.
4. File and dress edges with emery cloth.
5. Peen surfaces on lead or wood block.
6. Bend and form all parts as shown in illustrations.
7. Solder corners. Make certain that part *B* is large enough to slip on.
8. Solder support *C* to frame.
9. Rub all parts that are to be plated with steel wool.
10. Apply thick coating of copper.
11. Polish project with steel wool. Hold metal with a cloth to prevent hands from touching it.
12. Apply coat of clear metal lacquer and allow to dry.

RESEARCH ON STEEL INDUCED BY WAR WILL BE OF BENEFIT DURING PEACE

Many Studies Now Under Way Designed to Improve Aircraft Alloy Steels

Much of the research now under way in steel company laboratories is aimed primarily at improving military equipment, but many of the projects are also expected to be of benefit in peacetime.

Examination of a score of research projects at a number of different steel companies shows that most of the studies pertain to the improvement of alloy steels for the aircraft industry. However, much research along other lines is known to be under way through the steel industry.

Among the important projects now under study are investigations into the effects of temperatures upon the properties of metal. The war has subjected steel and other metals to more severe temperature tests than ever before. Obviously, enlarged knowledge about the effects of temperatures will be helpful in peacetimes.

Three companies have initiated programs of research on the related subjects of alloys, suitable for applications where high temperatures are a factor, such as are encountered in airplane superchargers and gas turbines.

A study of the heat treatment and ballistic resistance of steels for lightweight armor plate might appear at first glance to be strictly a wartime project, yet the findings may be valuable in improving steel for coal chutes and other purposes.

Postwar Possibilities in Gun Steels

Seeking improved steels for guns, several laboratories are cooperating in the study of improved compositions and heat treatments. The results should be applicable to other types of severe service, in postwar automotive engines, for example.

Another study that holds promise of peacetime benefits is devoted to the development of special stainless steel articles, such as springs, where an exceptionally high proportional limit and tensile strength are desired.

A number of research projects are centered upon welding. Fundamental studies on the heat-treating characteristics and metallography of boron-treated steels are also being made. A recently developed black oxide coating for stainless steel, which has already been introduced to steel users, is being further pursued from the research standpoint.

Other projects include: electropolishing processes for stainless steel; the commercial development of stainless steels possessing precipitation hardening properties; the mechanical properties and metallurgical characteristics of low alloy constructional steels; research on heat-treated stainless steel for aircraft structural members, research on alloy steel for certain highly stressed aircraft parts, and study of the effects upon steel of extreme cold, such as might be found at high altitudes or in the Arctics.—*Steel Facts*, December, 1944.

FOUR NEW TEACHING AIDS IN MECHANICAL DRAWING

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Probably no course of study in industrial arts or vocational education has undergone fewer changes during the past 25 years than mechanical drawing. New textbooks incorporating the recommendations of the American Standards Association (1935) have contributed much toward the standardization of the subject. There is less abstract work in the problems contained in the modern textbook. Defense training programs have played an important part in the policies of the school shops and drawing rooms. As a result many

Fig. 1. Projection stand; Fig. 2. Sketching the front view; Fig. 3. Sketching the end view; Fig. 4. Sketching the top view

of the instructors are giving more attention to the actual needs of the courses as they apply to the student and his work. Blueprint reading and sketching are now regarded as more important than the mere making of drawings involving technique. Obviously the majority of the students are not preparing for drafting vocations and the major objective is to teach students to have a working knowledge of mechanical drawing.

There is one phase, however, in the teaching of mechanical drawing which has been overlooked or regarded as not subject to any particular improvement. This is in the methods or teaching aids used by the instructor. Grasping the fundamentals of orthographic projection, isometric, perspective, and pictorial drawing is not easy for all members of a class. Teaching these units means that the instructor must give individual instruction and blackboard demonstrations, and stress the text material in the book. The student does the best he can to master these fundamentals. However, there are times when normal, intelligent, and willing beginners find it difficult to understand the printed page, oral instruction, or complex diagrams on the blackboard. In spite of all this there isn't a single teaching aid or teaching device on the market.

The Orthographic Projection Stand

The introduction of orthographic projection often seems a weary undertaking by the student. Even the instructor finds it difficult at times to "put it across" and have the class retain an interest in the course.

Some five or six years ago the writer decided some kind of a device as a teaching aid in presenting orthographic projection would prove helpful to students in the drawing room. The "glass box" idea is basically sound but using it as a portable teaching aid often failed to secure the expected results. Students often changed the position of the box in such a way as to defeat the purpose of the appliance. In the end, the pupil does not understand the relation of the top, front, and right-side views as he is expected to do.

The problem that confronted us was to design and construct an orthographic projection stand to support a model in one or more positions, but showing *only* the front, top, and right-side views. We wanted to fasten this projection stand to a table or shelf on the wall, allowing for some writing surface and a height convenient for any student short or tall. The plan was to place the observer directly in front of the projection stand and have him remain there until all three views were copied down on plain or cross-section paper. At the same time we wanted him to really see the top, front, and right-side views as they actually appeared before him and without disturbing the model or the stand.

After testing and experimenting on a number of ideas we developed the projection stand shown in Figure 1. After three or four years of constant use it seems almost an indispensable part of the drawing room equipment. Adults in defense training courses used it frequently in learning how to read blueprints and drawings.

The projection stand is not designed to take the place of the text material explaining orthographic projection. Neither is it intended to be used freely after a student has learned to make three-view drawings or sketches. The stand and a few models are merely suggested as a teaching aid in one of the most important units in mechanical drawing.

The projection stand we developed is simple in construction. All parts except the bracket shelf are made of metal. We made our own patterns and the castings were machined as required. We made six of them for testing purposes although one or two in a drawing room are enough. One was attached to a shelf on the wall. One or two were used as portable units and could be taken to any drawing table in the room. The others were fastened to specially made tables or stands and placed in different parts of the room.

The wall shelf unit was very satisfactory and took up little or no space in one corner of the drawing room. Incidentally, the blackboard behind the unpainted white pine models made an excellent background. The portable units kept the students at their tables but the expected did happen. A number of times a projection stand was knocked over and fell to the floor. The projection stands attached to the special stands or tables gave the best service. Shelves underneath for paper, models, and other material were a great convenience.

One of the projection stands was equipped with glass frames. Another was fitted with fine wire mesh screens and a third was fitted out with a transparent plastic material. We found after some time that the students did not like the frames attached to the bracket shelf. They seemed to be annoyed by the frames in front of the model. They preferred the stands without any materials representing the planes. Finally we discontinued the use of the frames and also any reference to the term *glass box*.

The bracket shelf has a swivel supporting spindle to hold the model. Each model is drilled on the under side with ⅛-inch holes. One hole is made near a corner and at an angle. This makes it possible to show auxiliary views and Revolution of Solids if desired.

The student stands in front of the projection stand and remains there until his sketching is done. He first raises the shelf to his own eye level. Then he sketches what he actually sees — the front view. His paper is in front of him on the writing surface at the base of the stand. Now he turns the shelf to the left as far as it will go. It can turn *only* in this direction and *only* ninety degrees. This gives him the right side or end view. See Figgure 3. This view is sketched on the paper to the right of the front view. After the shelf is turned back to its former position the pupil presses down on the finger bar and the shelf slowly descends to any point below the eye level. The top view is then studied by looking directly down on top of the model, and it is drawn directly over the front view on the paper. See Figure 4. During all this time the student's hands have been free to sketch, check, and manipulate the bracket shelf. The model was not touched or disturbed at any time.

The Layout Sheet

Along with the device already mentioned we experimented with a layout sheet. This paper takes the place of cross-section paper. It has the advantage of permitting students to project their lines from top to right-side views or vice versa by using the 45-degree

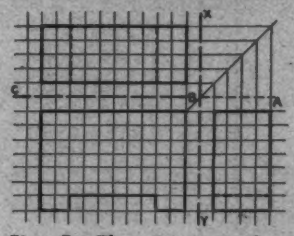

Fig. 5. The views on the layout sheet

line in the upper right-hand corner. But the principal difference is the fact that this layout sheet can be cut and folded in such a way as to *stand up* as is shown in Figure 6. When this is done it can be compared with the model and scanned for errors and omissions.

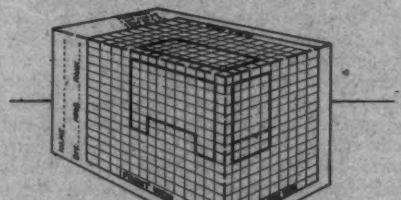

Fig. 6. Layout sheet folded to stand up

We had a cut made of this diagram and our print shop runs off a year's supply, using common 6 by 9-in. mathematics paper. See Figure 7. We use pale blue or light tan colored ink on the press. The impressions are barely discernible on the sheets and pencil lines made with a No. 2 pencil show up very well. Each view is generally drawn about one or two spaces from the folding lines. Our method is to use layout sheets at the beginning and then follow up with plain paper. Finally we require a sketch on plain paper without the projection stand, a model or a layout sheet.

Perspective Lines and Pointer

For some reason many instructors do not teach perspective drawing which is an important part of freehand sketching. The omis-

sion of this unit may be due to the limited amount of time a student can devote to a year in mechanical drawing. However, the principles involved can be easily shown on the blackboard with the perspective appliance shown. Beginners *catch* on in less than one period and derive quite a bit of satisfaction in being able to show some progress after a trial at the blackboard.

Two screw eyes are fastened to the upper edge of the blackboard casing about 6 ft. apart. A braided line is passed through the screw eyes and on each end is suspended a small weight of some suitable material. Anything will do as long as it does not mar the casing. See Figure 8.

The pointer, shown in Figure 9, is ideal for holding the line while chalking the lines leading to the vanishing points. You will notice the offset on the tip of the pointer. This allows for space under the line so a student can chalk his lines without disturbing the braided line. The pupil is told the screw eyes are the vanishing points. A few trials on the blackboard is all he needs. He then goes to his table and as a rule does very well in making a similar perspective sketch on paper without any rule, scale, or guide to direct his pencil lines toward the upper corners of his paper. This teaching aid is very effective and has proved to be helpful and interesting to its users.

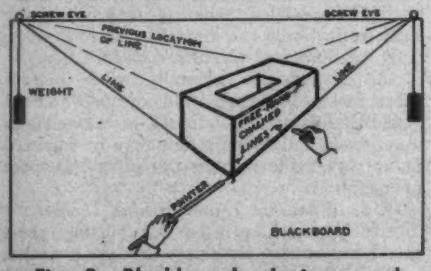

Fig. 8. Blackboard device used for teaching free-hand perspective drawing

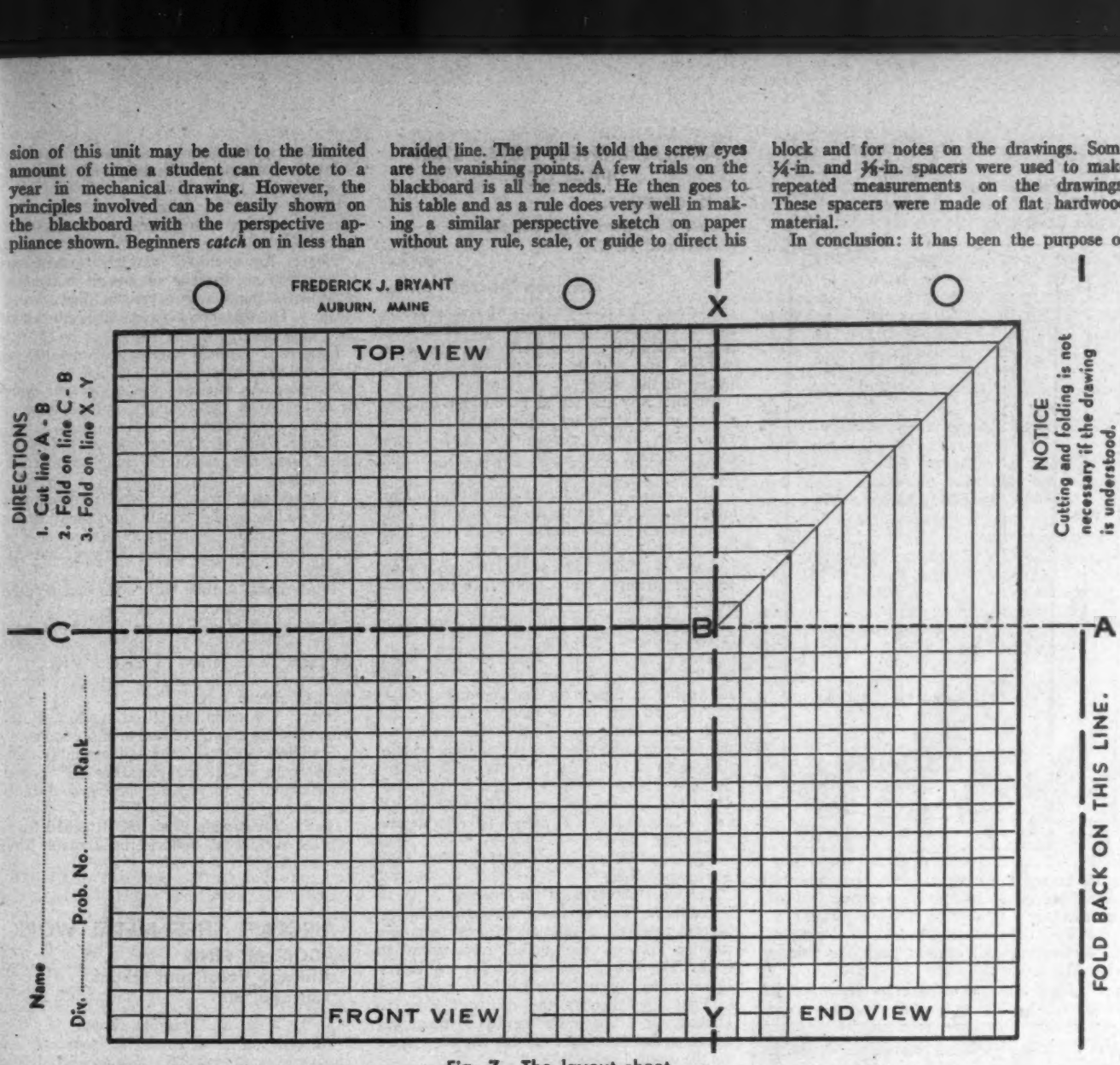

Fig. 7. The layout sheet

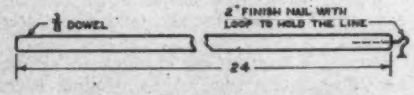

Fig. 9. Perspective pointer

Guide Line Spacers

Good lettering is essential to well-made drawings. This means not only practice in lettering but accuracy in drawing guide lines of the proper width. Slight variations in spacing the lines are often noticeable when used for lettering purposes.

Some time ago we made a number of guide line spacers as shown in this article. Most of them were made of ¼-in. dowels and phonograph needles. See Figure 10. Jigs were made in the shop and we made about one hundred ⅛-in. spacers. Some had points on both ends. They were used in marking off measurements, spacing guide lines in the title block and for notes on the drawings. Some ¼-in. and ⅜-in. spacers were used to make repeated measurements on the drawings. These spacers were made of flat hardwood material.

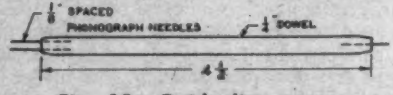

Fig. 10. Guide line spacer

In conclusion: it has been the purpose of this article to call attention to teachers of drawing that there must be many other teaching aids which should be brought to light. It would be quite gratifying to learn from the readers of this magazine that better and more practical equipment is in use. If you have something which is "good" why not let us in on it?

WIRE GAUGE

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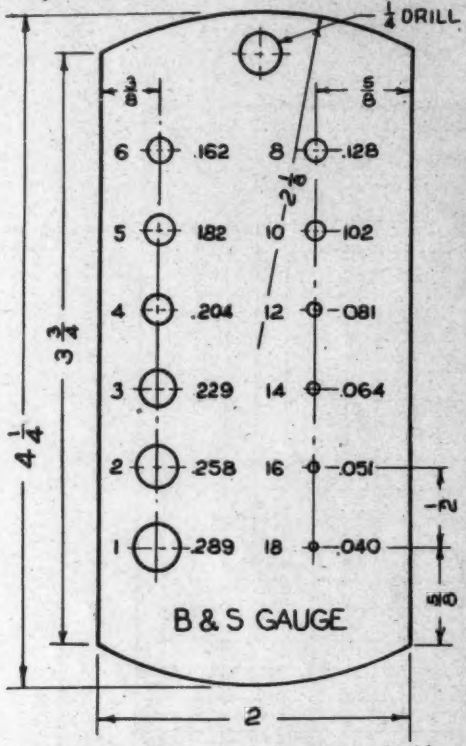
The wire gauge described herewith will be found very useful for students in electrical construction in identifying wire sizes. Cable capacities can also be calculated as most of the strands fall between No. 18 and No. 8.

The accompanying table shows the gauge number and drill size to use for drilling the various holes. The wire sizes shown were taken from the *Anaconda Handbook of Magnet Wires*, and show the variations allowed in wire drawing. The decimal diameter of the drills are given to show how close the drill sizes match the nominal wire sizes.

Material required: 1 pc. ⅜ by 2 by 4⅜ in. C.R.S.

To make the gauge:

1. Draw file one side smooth and apply layout fluid.



2. Locate the center of the stock and with the dividers set at 2⅛ in., describe two arcs as shown.

3. File the ends to shape.

4. Lay out and center punch the holes to be drilled.

5. Drill the four small holes first, in order, 60, 55, 52, 46.

B. & S. GAUGE NUMBER	DRILL		WIRE DIAMETERS		
	NUMBER OR LETTER	DIAMETER	MINIMUM	NOMINAL	MAXIMUM
1	L	.290	.2864	.2893	.2922
2	F	.257	.2550	.2576	.2602
3	1	.228	.2271	.2294	.2317
4	5	.204	.2022	.2043	.2063
5	13	.182	.1801	.1819	.1837
6	20	.161	.1604	.1620	.1636
8	30	.127	.1272	.1285	.1298
10	38	.1015	.1009	.1019	.1029
12	45	.081	.0800	.0808	.0816
14	52	.0635	.0634	.0641	.0647
16	55	.050	.0503	.0508	.0513
18	60	.039	.0399	.0403	.0407

6. Drill all the rest of the holes with the 46 drill.

7. Drill the rest of the holes in a series, increasing them one wire gauge at a time.

8. Draw file both sides and all edges.

9. Stamp on the numbers, student's name, etc., with 1/16-in. stamps.

10. Draw file lightly and polish.

Man starts nine-tenths of all our forest fires, lightning only one-tenth. Most people are afraid of lightning, but foresters are more afraid of people. The total area burned over each year by forest fires in the United States is about as large as New York state. — *American Forest Products Industries, Inc., Washington, D. C.*

AIRPLANE SHEET-METAL SHOP PRACTICE

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Common Aircraft Terms

Aileron: The movable part of a wing which enables the plane to bank or roll. It is usually found on the outer portion of the wing near the tips, and on the trailing edge. It is hinged to the wing.

Airfoil: Any surface or part which obtains a reaction as it moves through the air, such as a wing, rudder, aileron, etc. Airfoils are given different shapes to obtain desired air reaction.

Air scoop: A hood to catch air to maintain pressure in ventilators, carburetors, etc.

Amphibian: An airplane which can land or take off on either land or water.

Angle of attack: The angle at which a wing or other airfoil is set in relation to the direction of airflow.

Aspect ratio: The ratio of the wing span to the chord of the wing.

Axes of an airplane: There are three axes, vertical, longitudinal, and lateral. The vertical axis is an imaginary line running through the forward part of the plane vertically; the longitudinal axis runs through the center of the fuselage from nose to tail; the lateral axis runs from one wing tip to the other. They are the axes about which the plane is balanced. The axes are referred to by letters, i.e., *X* axis — longitudinal; *Y* axis — lateral; *Z* axis — vertical.

Biplane: An airplane with two wings, one above the other.

Cabane: Struts used for bracing.

Camber: The curve of an airfoil top or bottom member in relation to a straight line running through the airfoil from front to back. The upper camber of a wing is the upper curve of the wing rib in relation to a straight line through the rib from nose to trailing edge. The lower camber is the lower curve or bottom part of the rib in relation to the same longitudinal line.

Center section: A wing usually consists of three parts, the central section which attaches or is part of the fuselage, and two outer panels.

Chord: A straight line through an airfoil, from the leading edge to the trailing edge. The upper and lower camber are figured from the chord line.

Controls: The means by which the pilot controls speed, direction, altitude, power, etc., of an airplane.

Control surface: A movable airfoil which enables the pilot to maneuver the airplane, i.e., aileron, rudder, elevator.

Cowling: A removable covering usually around an engine or cockpit.

Dihedral: An angle formed between two airfoils such as right and left wing. The angle is measured from the relationship of a line, from wing tip to wing tip, and the lateral axis of the plane.

Drag: Air resistance to forward motion.

Elevator: A control surface which enables the pilot to ascend or descend. It is usually hinged to the stabilizer, and is part of the tail assembly.

Fairing: Part of a structure whose function is to reduce drag on the part to which it is fitted.

Fin: May be fixed or adjustable. The fin is part of the tail assembly, and its function is to give directional stability. The rudder is usually hinged to the fin.

Feather: This term is applied to the increase or decrease of the angle of incidence of a propeller blade or wing.

Flap: An airfoil fastened to the trailing edge of another airfoil such as a wing. Its function is to change the camber of the wing.

Float: An enclosed watertight structure fastened to an airplane to give it buoyancy in water. A pontoon is a type of float.

Gap: The distance between adjacent wings on a multiplane.

Longeron: A main longitudinal member of the fuselage frame.

Nacelle: An enclosed space, part of wing or attached to the fuselage, for carrying a motor or passenger.

Panel: Part of a wing constructed separately from the rest of the wing to which it is attached.

Primary structure: Any structural member whose failure would impair the safety of the plane is part of the primary structure. The main framework, including fittings and attachments.

Pitot tube: A tube with open end pointed up to measure impact pressure.

Rudder: A hinged or movable airfoil, part of the tail assembly. Its function is to enable the plane to be turned to right or left.

Shroud: A strip used to seal the wing at the flap aileron gap.

Spar: The main structural support of the wing. A wing may have one or more spars.

Stabilizer: Part of the tail assembly. The member to which the elevators are hinged. Its function is to provide increased stability in flight.

Tab: An auxiliary airfoil attached to a control surface to reduce the control force of the member.

AIRCRAFT SHEET-METAL WORK

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Chicago, Ill.

Q. 1. *What are squaring shears?*

Ans. A machine used for squaring and cutting sheet metal. This machine consists of two blades operated either by foot or motor power.

Q. 2. *What are gap-squaring shears?*

Ans. These shears resemble the regular squaring shears. The gap-squaring shears can cut any length sheet required. This machine is used where the regular squaring shears are too narrow to split long sheets.

Q. 3. *What are slitting shears?*

Ans. They are used to slit sheets in lengths where the squaring shears are too narrow to accommodate the sheet of metal. The lever type of slitting shears are known as lever shears and are used for cutting heavier grades of sheet metal. Never cut bolts or rods with these shears as narrow, rounded material will break down the cutting edges of the blades. A special attachment is necessary for such work.

Q. 4. *What are throatless shears?*

Ans. A machine generally made to cut sheet metal 10 gauge mild carbon, and 12 gauge stainless steel. Sheets of any length may be cut and irregular line may be followed or notches made without distorting the sheet of metal.

Q. 5. *What are rotary slitting shears?*

Ans. A machine used for slitting sheet metal and cutting irregular curves and circles.

Q. 6. *What are ring and circular shears?*

Ans. Shears used for cutting true circular disks in sheet metal. Before cutting the disks,

the metal should be cut in squares about ¼ inch larger than the circle desired.

Q. 7. *What are unishears?*

Ans. The trade name of the newer type of power circle cutting shears. This type of machine will cut circles as small as 3 inches in diameter.

Q. 8. *What is the nibbler machine?*

Ans. Similar design as the unishear. Nibblers are usually made to cut mild steel up to 1½ in. in thickness and are very useful in manufacturing airplane fittings.

Q. 9. *What is a folding machine?*

Ans. A machine used for turning edges, flanging, preparing straight sheets for wiring, and preparing the edges of pipes, cans, buckets, boxes, etc., preparatory to grooving. The bar folder and the pipe folder are the most commonly used types.

Q. 10. *What is a brace and wire bender?*

Ans. A machine used for making braces, handles, etc., on buckets, boxes and tanks with iron bar stock and wire and rod. This metal is too heavy to form on the folder or cornice brake.

Q. 11. *What is a cornice brake?*

Ans. A machine used to form double locks, Pittsburg locks, and countersunk seams. Various additional shapes can be formed, such as square, angular, quarter round, round, and ogee bends.

Q. 12. *State the use of a forming roll machine.*

Ans. This machine is used for forming sheet metal into cylinders of various diameters. The forming roll is known as a slip roll former. Small pipes and cylinders can easily be formed on this machine.

Q. 13. *State the use of a grooving machine.*

Ans. This machine is used following the forming rolls in many operations. All standard grooving machines have sets of grooving wheels for seams of various widths. The grooved wheel is used where the seam is to finish on the outside of the work. An adjustable horn or arm with different sizes of grooves is used where the seam is to finish on the inside.

Q. 14. *State the use of a turning machine.*

Ans. This machine is used for preparing a seat in the tops of vessels for receiving a wire as well as for turning the double edge on elbows when no elbow machine is available.

Q. 15. *What is a wiring machine?*

Ans. The wiring machine follows the turning machine in the production of wired edges. The seat or edge of the metal is notched and turned for receiving the wire by means of the turning machine, and a wire of the required diameter is placed in this seat.

Q. 16. *State the use of a burring machine.*

Ans. The burring machine can be used in place of the turning machine in some cases. It is used for turning flanges and edges on round covers and in bottoms for cans and tanks. It is also used for double seaming and for turning single edges on elbows.

Q. 17. *State the use of an elbow machine.*

Ans. The elbow machine is the same in construction as the turning machine, with the exception of edging rolls, which vary in shape according to the type of edge desired.

Q. 18. *State the use of a setting-down machine.*

Ans. This machine is used for tightening down the edges made on the burring machine preparatory to double seaming.

Q. 19. *When is a double-seaming machine used?*

Ans. After the setting down operation has been performed on the bottom of the project the seam must be turned up tight against the side, either by means of a mallet over a stake or by a double-seaming machine.

Q. 20. *What is the purpose of a beading machine?*

Ans. It is used to turn beads on pipes, cans, buckets, or fenders, both for stiffening and ornamental purposes. In order to prevent buckling or breaking of the metal the machine may also be used on sheet stock that is to be welded.

Q. 21. *What use is the power raising hammer?*

Ans. Because of its speed in working heavier metals it has been adopted by aircraft manufacturers for such work as raising, flanging, riveting, scarfing, and flattening of sheet metal parts.

Q. 22. *State the use of a metal cutting band saw.*

Ans. In the repair and replacement of airplane fittings. This machine is very handy when the plate material from which airplane fittings are made is too heavy to be cut with shears, and the time required to set up the job on a milling machine or shaper is short. These pieces may be blanked out or cut to approximate shape on the metal cutting band saw.

Q. 23. *What are stakes?*

Ans. Sheet metal is usually shaped over various forms called stakes. The stakes are to the sheet metalworker what the anvil is to the blacksmith.

Q. 24. *What is a spinning lathe?*

Ans. The spinning lathe is different from other metal lathes as it has no back gears, carriage, or lead screws. This lathe is used for metal spinning — because speed is a very important factor in this work.

Q. 25. *Name the various shapes of tools used in metal spinning.*

Ans. (1) Hand tool holder; (2) All purpose flat tool; (3) Pointing tool; (4) Cut-off tool; (5) Beading tool; (6) Ball tool.

Q. 26. *Why is a lubricant necessary on the surface of the metal in metal spinning?*

Ans. Because of the friction developed while the metal is spinning.

Q. 27. *What lubricant should be used on the surface of the metal in metal spinning?*

Ans. Cup grease or yellow laundry soap is used for pewter, aluminum, and copper. Tallow candles are often used for the extremely hard metals.

Q. 28. *State the use of hand snips and shears.*

Ans. Hand snips and shears are used to cut metal as heavy as 20 gauge. Hand snips are made in various sizes and in the straight, regular, and circular types.

Q. 29. *State the use of regular and straight snips.*

Ans. Regular or straight snips are used for cutting a straight line or circle of large diameter. Snips should never be used in place of pliers or wire cutters nor should they be used on material heavier than that for which they are intended as snips that have been sprung are useless.

Q. 30. *State the use of double cutting shears.*

Ans. These shears are used for cutting light sheet iron pipe, stacks, and cylinders.

Q. 31. *State the use of circle snips.*

Ans. These snips have curved blades and are used for scrolls and circles of all diameters.

Q. 32. *What are bench shears?*

Ans. Bench shears are large shears used for cutting sheet metal from 20 to 16 gauge.

Q. 33. *What are aviation snips?*

Ans. Aviation snips have blades with small teeth on their cutting edges. These snips are constructed especially for cutting heat-treated aluminum alloy and stainless steel.

WHITTLING-JACKKNIFE TECHNIQUE

W. BEN. HUNT
Hales Corners, Wis.

(Continued from page 26 of the January, 1945, issue)

The Otter

The otter shown in Figure 168, like most animals living in the water and living on fish, is extremely streamlined, and for that reason is a pleasing subject to work on. For those who have been following this series, not much need be said about how to whittle this pleasing project. The five views shown in Figure 169 tell the story in detail. After the silhouette has been sawed out lay out the general shape of the top view, drawing it on top. Then black it out with a knife before starting to work in the round. When it comes to finishing, carefully sandpaper the otter only, and leave the base more or less rough. Then stain the otter with walnut stain and when dry give the whole thing a few coats of wax or, if you prefer, a couple of coats of lacquer or shellac.

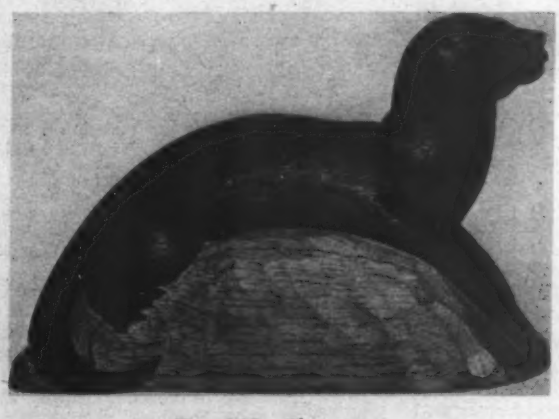


Fig. 168. The otter

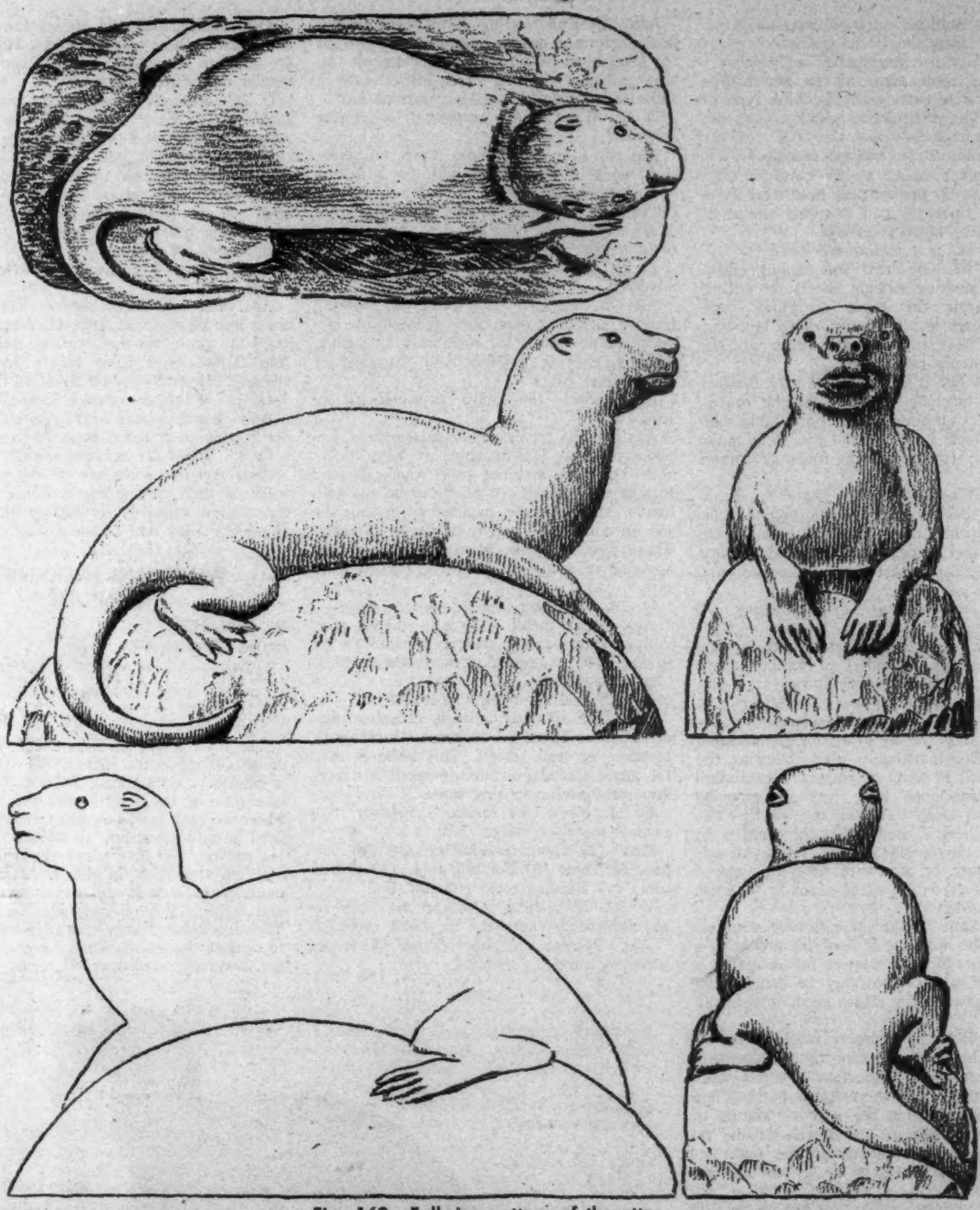


Fig. 169. Full-size pattern of the otter

OBJECTIVES OF GENERAL EDUCATION FOR MEMBERS OF THE ARMED FORCES*

General education should lead the individual as a citizen in a free society:

1. To improve and maintain his own health and take his share of responsibility for protecting the health of others.

2. To communicate through his own language in writing and in speaking at a level of expression adequate to the needs of educated people.

3. To attain a sound emotional and social adjustment through the enjoyment of a wide range of social relationships and the experience of working cooperatively with others.

4. To think through the problem and to gain the basic orientation that will better enable him to make a satisfactory family and marital adjustment.

5. To do his part as an active and intelligent citizen in dealing with the interrelated social, economic, and political problems of American life and in solving the problems of postwar international reconstruction.

6. To act in the light of an understanding of the natural phenomena in his environment in its implications for human society and human welfare, to use scientific methods in the solution of his problems, and to employ useful nonverbal methods of thought and communication.

7. To find self-expression in literature and to share through literature man's experience and his motivating ideas.

8. To find a means of self-expression in music and in the various visual arts and crafts, and to understand and appreciate art and music as reflections both of individual experience and of social patterns and movements.

9. To practice clear and integrated thinking about the meaning and value of life.

10. To choose a vocation that will make

*As stated in "A Design for General Education" in the 1944, American Council of Education Studies.

optimum use of his talents and enable him to make an appropriate contribution to the needs of society.

Some of these objectives are closely related and could be subsumed under fewer categories. Certain aspects of general education have frequently been neglected, however, and therefore it seemed desirable to give these phases emphasis by specific statement.

PRINTED CHECKER-BOARD SETS FOR SERVICEMEN

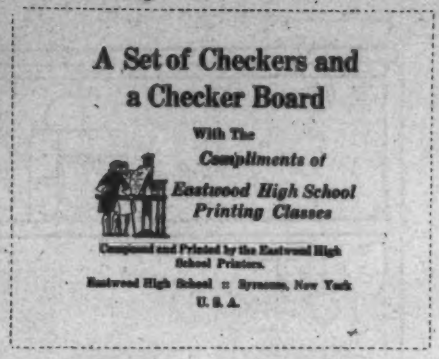
BERNARD J. HESS
Eastwood High School
Syracuse, N. Y.

Four thousand of the checker sets shown in the illustration were printed by the students of the print shop of Eastwood High School print shop, Syracuse, N. Y., for distribution to men in military camps both here and overseas by the Red Cross. The sets were designed to fit into the servicemen's kits. Expenses were met by the Alumni Association, sports teams, fraternities in the school, and the pupils in the shop.

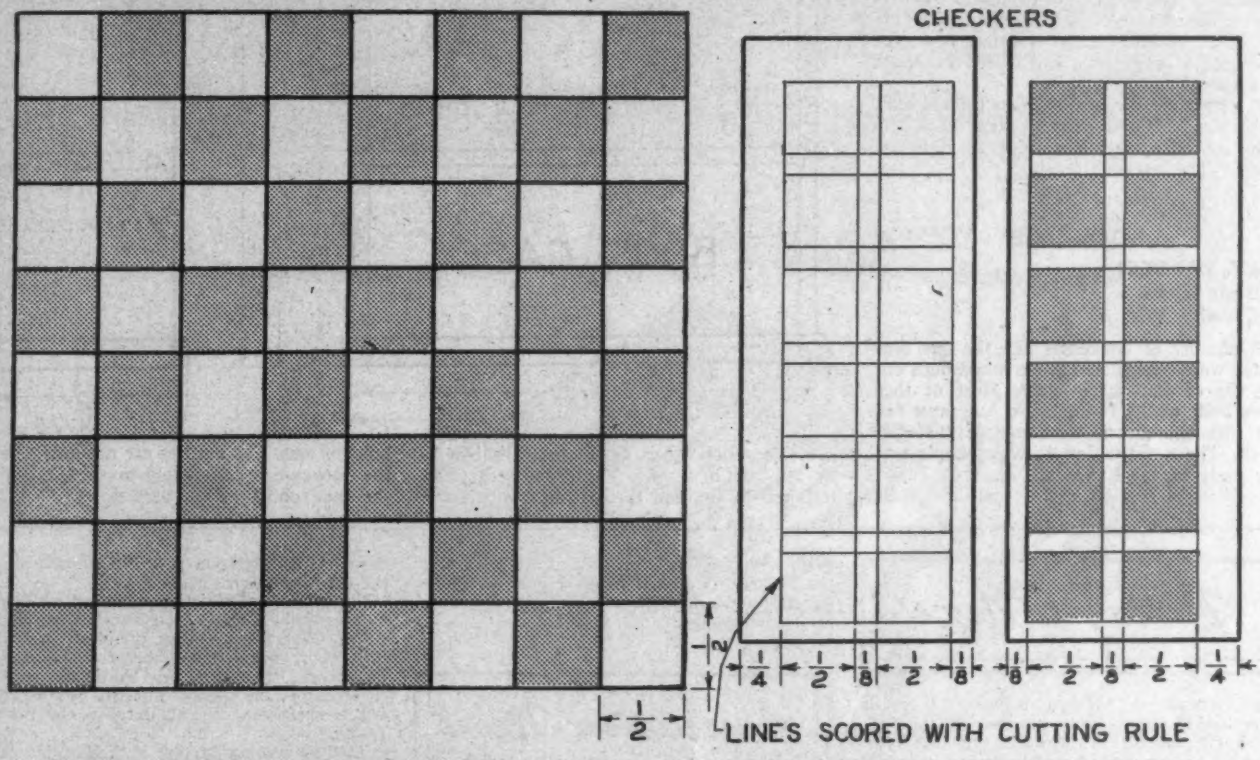
Not only was this a worth-while project as a wartime printing job, but it also proved to the student that he could contribute to the morale of the armed services through printing. The checker board provided a good lesson in planning and spacing, while the checkers illustrated the use of the cutting rule. The setting of the envelope was an opportunity to use initiative in display.

Reports from the boys in service showed that these games were well received. Some said that they carried the boards entirely around the world and used them until they were literally falling apart.

Score pads for various card games are now in preparation to be sent to USO centers and camps.


A Set of Checkers and a Checker Board
With The
Compliments of
Eastwood High School
Printing Classes
Designed and Printed by the Eastwood High School Printers.
Eastwood High School :: Syracuse, New York
U. S. A.

5⅛ by 4¼-in. envelope for checker set



Checker board and checkers printed in black and red on chip board. The back of the board carried the following information: A set of checkers and a checker board. With the compliments of Eastwood High School printing classes, Syracuse, N. Y.

SAFETY IN THE SCHOOL SHOP

SAMUEL F. HALL
High School
Clayton, Mo.

(Continued from page 40A of the October, 1944, issue)

Electrical Hazards

General Information

Electricity has become a most useful servant. But like most other natural and man-made servants, it can be the cause of considerable grief if it is not handled with caution and *treated with respect*. For instance, defective equipment and unsafe acts may cause electric shock or burns, or flashed eyes, or they may cause the ignition of flammable material, dust, or vapors.

Specific Information

1. Use high-grade electrical equipment that has been tested.
2. Electrical toys are safe if they are of good quality.
3. Overloading a circuit will blow out a fuse.
4. Fuses should be of ample size.
5. Do not replace fuses with the current on.
6. Watch for defective switches. Open switches are dangerous.
7. Common key switches are not recommended for large machines.
8. Do not leave dangling *hot* wires in the electrical department.
9. Use the same care with electricity at home that you use in the school shop.
10. All machines should be grounded.

Assignment

1. What do we mean when we say an electric device has been tested? .....
2. What danger exists when a fuse is replaced with a penny? .....
.....
3. When fuses are removed, what precautions should we observe? .....
.....
4. What is the danger of climbing light or telephone poles? .....
.....
5. What dangers are there in installing a radio aerial? .....
.....
6. Is wire a good material to use in stringing a kite? Why? .....
.....
7. Why is it dangerous to touch electrical fixtures while standing in a damp place? ....
.....
8. To whom would you report dangerous wires? .....
9. Explain what you would do in case someone was shocked with a fallen wire. ....
.....
.....
.....
10. Note here some good conductors, poor

conductors, and types of insulation for electrical work.

. . . . . .

. . . . . .

. . . . . .

Discussion

1. Collect folders which accompany electrical appliances and note precautions to be observed.

2. Pick out one room in a house at a time. List the electrical appliances which might be used. Discuss the dangers and safety features of each appliance.

Optional Assignment

1. Compute the following problem. In one year due to carelessness with electricity the fire loss was $18,632,270. Thirty-seven per cent of this loss was caused by improper use of electric irons and cords. What was the cash loss by improper use of irons and cords?

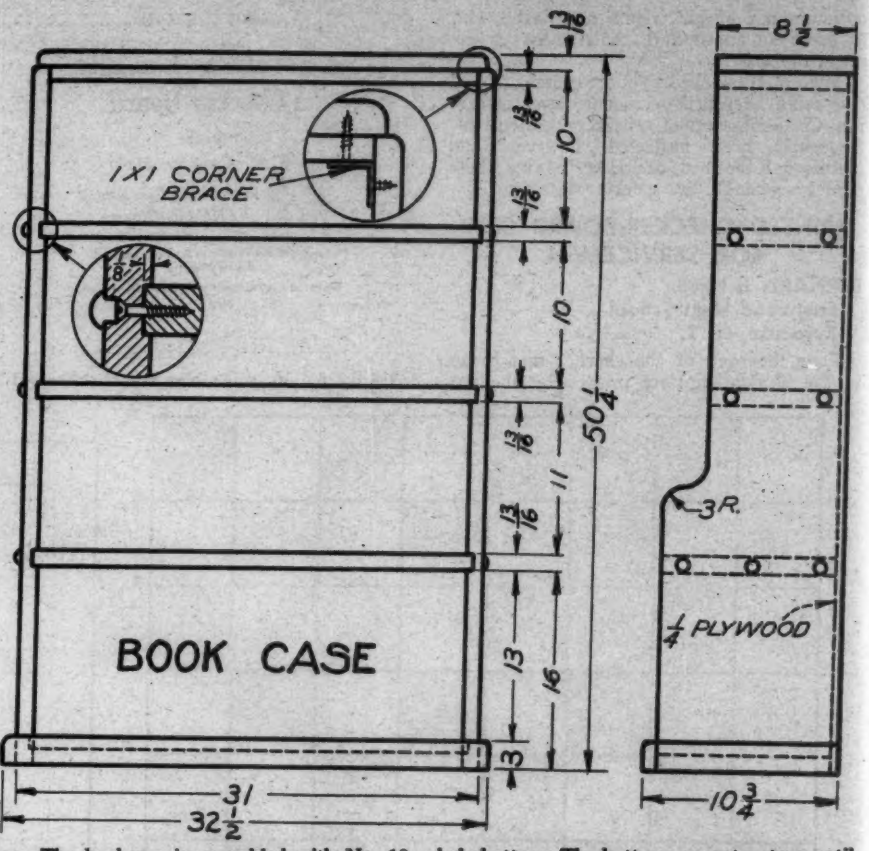
2. Dramatize a scene showing how you would aid a person who had received a shock by a fallen wire.

3. *Foreman.* Write a letter to International Inspectors, 85 John Street, New York, for "How to Safeguard Electric Service in the Home." The leaflet is free.

BOOKCASE

LOUIS BAROCCI
High School
Cudahy, Wis.

A number of bookcases like the one illustrated were constructed in our woodshops during the current school year. Most of them were built of 13/16-in. black American walnut, although several were made of 13/16-in. birch. The construction is very simple once the ends of stock are all squared. This is usually done for the student on the circular saw. The bookcase is assembled with No. 10 by 1½-in. f.h. screws. The screws are counterbored ¼ in., and then covered with screw hole buttons. The buttons are not put on until the bookcase is completely finished, including the final rubbing of the varnish.



Personal News

♦ LAWRENCE G. LINDAHL is now director of Gunnison Homes Institute, subsidiary of the U. S. Steel Corporation in New Albany, Ind. Mr. Lindahl was an instructor in trade and industrial education at Purdue University and was recently graduated with the degree of doctor of philosophy. He did his research for the dissertation in the plant of P. R. Mallory, Inc., Indianapolis, Ind. His major was in industrial psychology.

Before going to Purdue, he spent 12 years as professor and head of industrial arts at the State Teachers College, Chadron, Neb.

♦ FRANK MANN, who received his master's degree at The Stout Institute, Menomonie, Wis., in 1940, is now a co-ordinator for the Chrysler Corporation employees in the Apprentice School, Detroit, Mich.

♦ A. L. THIEDE, who was on military leave from the State Teachers College, Mankato, Minn., was killed on November 6, 1944, when a Navy transport plane in which he was flying collided with one of our fighter planes.

He had been a member of the faculty at State Teachers College since 1934.

♦ EUGENE CARLILE has been appointed director of the evening school program at Abilene, Kans. Mr. Carlile formerly was instructor of industrial arts in the high school.

♦ HAROLD MCCLEAVE has been appointed to serve as director of the evening school program at Atchison, Kans. He has taught social science in the Atchison High School for the past eleven years with the exception of a short sojourn in the State of Washington as ground school instructor, and a semester as social science instructor at Independence, Kans.

Association News

A.V.A. CONVENTION

The American Vocational Association which met at Philadelphia, Pa., December 6-9, 1944, to hold its thirty-eighth annual convention, spent the major portion of its deliberations on the problems of reconversion training programs.

The general attendance exceeded all expectations and the majority of the meetings were packed with interested listeners.

Members of the National Council of Local Administrators of Vocational Education and Practical Arts made tours of Philadelphia's schools and industries as early as Monday of the convention week. On Tuesday they met to discuss "The Role of Local Administration of Vocational Education and Practical Arts in Dealing With Current and Postwar Problems," and "The Role of Local Administrators of Vocational Education and Practical Arts in Dealing With Current and Postwar Problems."

At their dinner meeting, held Tuesday evening at 6:30, Howard A Campion, president, National Council of Local Administrators, presided.

The main address on this occasion was delivered by John A. McCarthy, president of American Vocational Association, and assistant commissioner of education, State Department of Public Instruction, Trenton, N. J. He outlined some of the major problems which the schools must solve in the postwar period, and warned that lag in the educational field would inevitably make the reconversion period more difficult for the entire country.

The National Association of Industrial Teacher Trainers held a meeting on Tuesday morning at which Gilbert G. Weaver, president, and State Supervisor of Industrial Teacher Training, State Education Department, New York City, presided.

Here, too, the special emphasis was on training teachers for efficient duty in the postwar period.

At their evening meeting L. S. Hawkins, director, Vocational Training for War Production Workers, U. S. Office of Education, Washington, D. C., outlined what the vocational teacher must possess in the way of practical and teacher training to be a real success.

He was followed by Felix Averil, specialist in teacher training, U. S. Office of Education, Washington, D. C. Mr. Averil emphasized the need of analyzing not only what they are to teach but how they are to teach as well.

Roger Zinn of the Jam Handy Co., Detroit, Mich., presented an instructional unit which his firm had prepared on safe practices in woodworking. An excellent discussion on the proper length of a film slide presentation resulted.

At the business meeting, Dr. Walter B. Jones, associate professor of education, University of Pennsylvania, Philadelphia, Pa., was elected president for the ensuing year. The other officers for the coming year are: first vice-president, Edward Williams, professor of industrial education (on leave), A. & M. College of Texas, College Station, Tex.; second vice-president, Dr. Raymond Phipps, director of industrial education, State Teachers College of Connecticut, New Britain, Conn.; secretary-treasurer, Dr. S. Lewis Land, head, department of industrial education, Pennsylvania State College, State College, Pa.; board of trustees, Dr. Harold Silvius, Wayne University, Detroit, Mich.

At the joint meeting, National Association of State Supervisors of Trade and Industrial Edu-

(Continued on page 22A)

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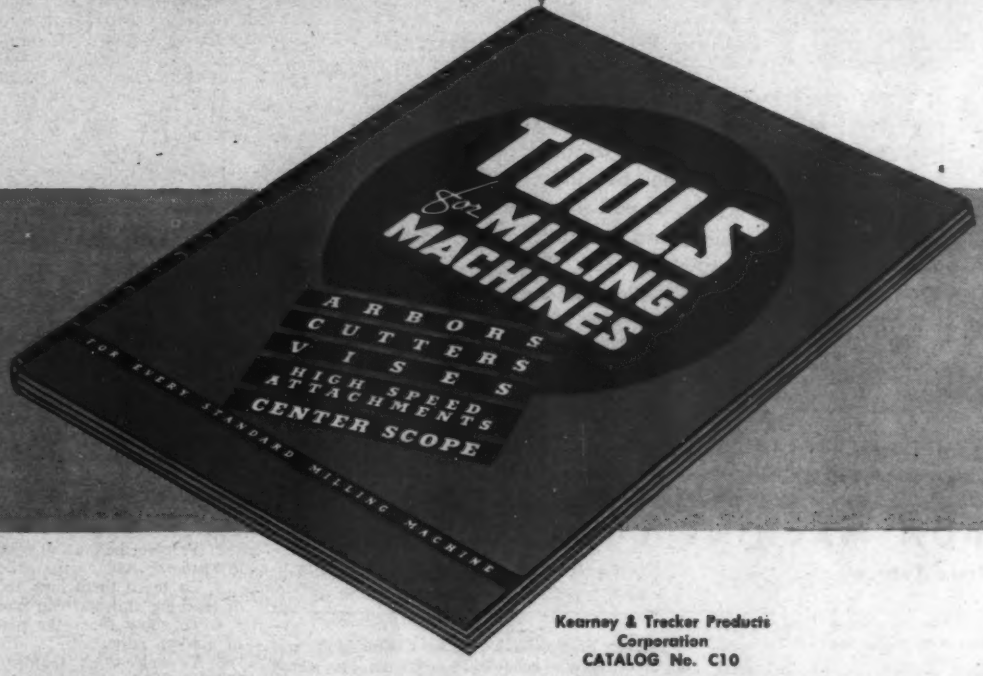

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SHELDON BBU-1242 WQ PRECISION LATHE

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If interested in 10", 11" and 12" quality lathes be sure to see the SHELDON.

SHELDON MACHINE COMPANY, INC.

4244 N. Knox Avenue **Chicago 41, U. S. A.**

(Continued from page 86)

cation and National Association of Industrial Teacher Trainers, held Tuesday afternoon, S. Grant Conner, U. S. Office of Education, Washington, D. C., in his address on "Improving the Effectiveness of Vocational Education, Through Well-Organized Local Supervision," suggested that improvements might well result from changes within the organization itself, and that such improvements would be reflected by the progressive leadership of administrative and supervisory personnel which would help the teaching staff to function more efficiently, and that would influence the community to accept the program more readily.

The opening session on Wednesday evening was presided over by John A. McCarthy, president.

In his outstanding address on "Education for *All* American Youth," Alexander J. Stoddard, chairman, Educational Policies Commission, and superintendent of schools, Philadelphia, Pa., stated that what happens to youth is not their problem but ours. Education in the postwar period must not be split up between governmental agencies but must remain in the hands of the school. It will be best if the state and local community can do the job because if the Federal Government takes it over, flexibility will be lost. Federal subsidies should be limited to the building and maintenance of schools and institutes but it is not to have authority and control over education beyond seeing that the money it has furnished is spent properly.

What America is willing to spend on its postwar schools depends upon the understanding, vision, and statesmanship of our educators and political leaders. We must not pinch the pennies for peace, who now deal out dollars for destruction.

The industrial-arts education section on Thursday morning was under the chairmanship of Arthur F. Hopper, assistant superintendent of schools in charge of industrial arts education, Plainfield, N. J.

At this session "Industrial Arts in the Senior High School" was discussed. The first speaker, Major Ralph C. Wenrich, chief, Pre-Induction Training Service, Military Training Division, Washington, D. C., emphasized that industrial-arts courses to be of benefit to the inductee should emphasize skill with hand tools, give foundational skill in a variety of occupational areas, stress thoroughness and accuracy, and develop leadership qualities.

Ralph Pickett, chairman, Department of Vocational Education, and director of New York University Training Program for War Industries, who spoke on "Problems of Industrial Arts in the Senior High School," warned that the fact that equipment after the war may be obtained easily should not prompt anyone to equip with anything that will not be used. Take what is needed, nothing else.

In the same way, do not allow yourself to be stampeded into using courses, methods, and materials that serve no good purpose.

Industrial-arts courses should be taught only by well-qualified teachers, and industrial-arts teachers should be particularly careful not to squabble within their own ranks.

Earl B. Milliette, director, Fine and Industrial Arts, Philadelphia Public Schools, Philadelphia, Pa., in his address on "A Suggested Program for the Future Industrial Arts in the Senior High School," deplored the fact that industrial arts in high school unfortunately is still looked upon by many school administrators as a mecca for the academic misfits. Industrial arts should give the student (1) an acquaintance with industrial products, practices, and materials; (2) shop experiences that are prevocational, not vocational; (3) an industrial literacy which can act as a balancing factor; (4) a personality development which helps him share with others, cooperate with them, and possess tolerance.

The afternoon session was under the chairmanship of Roy G. Fales, state supervisor of industrial arts, Albany, N. Y.

Lt. Col. Verne C. Fryklund, chief, Educational Branch, Convalescent Activities Division, Office of the Surgeon, AAF Personnel Distribution Command, Atlantic City, N. J., presented a graphic picture of "The Attitudes of the Returning Veteran and the Adjustment Problem He Faces."

Burl N. Osburn, State Teachers College, Millersville, Pa., described what should be done at teacher-training institutions in the way of "Refresher and Retraining Courses for Industrial Arts Teachers."

William T. Bawden, State Teachers College, Pittsburg, Kans., in speaking about "Some Problems Faced by Postwar Industrial Arts Teacher Education," stated that the aims of teacher education in industrial arts may be summarized to be:

1. Attract and select young men and women who give promise to succeed as teachers of shopwork and drafting.
2. To give them an understanding of the learning process, and of the child mind.
3. To teach them how to apply the principles of teaching and teaching methods.
4. To show them the place of industrial arts in modern education.
5. To help them acquire a knowledge of industry and industrial processes and equip them with the required skill in shopwork and drafting.

An important problem that confronts teacher-training institutions is to evaluate their work and to improve it for the important work that confronts industrial arts and vocational education in the postwar period.

John R. Ludington, University of North Carolina, Raleigh, N. C., acted as discussion leader at this session.

E. E. Ericson, Santa Barbara State College, Santa Barbara, Calif., gave a report on the activities of the A.V.A.'s industrial-arts planning committee.

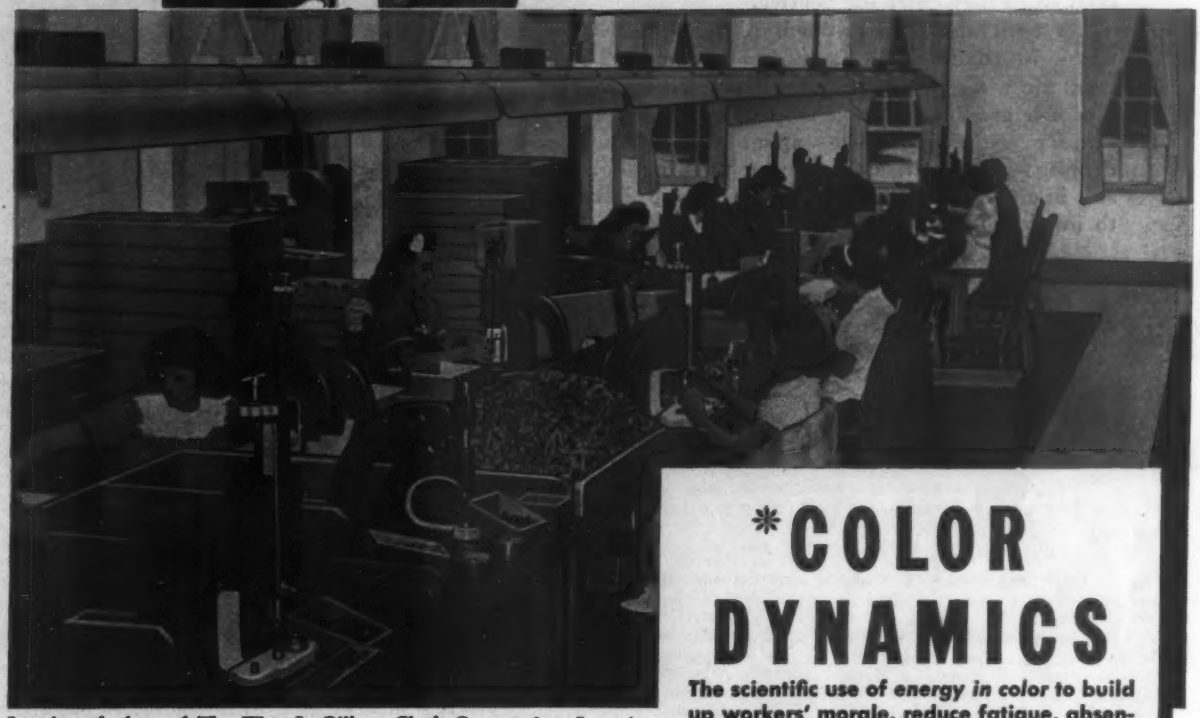
The Friday morning industrial-arts session under the chairmanship of Frank C. Moore, director of industrial arts, Cleveland, Ohio, was devoted to a study of the "New Problems Confronting Junior High School Industrial Arts."

Kenneth Brown, assistant director of industrial arts, Philadelphia, Pa.; Horace M. Jellison, executive director of industrial arts and vocational

(Continued on page 24A)

Teach your students . . . Pittsburgh's new system of

COLOR DYNAMICS*



Interior of plant of The Wm. L. Gilbert Clock Corporation, Laconia, N. H., after repainting according to principles of COLOR DYNAMICS.

***COLOR DYNAMICS**

The scientific use of *energy in color* to build up workers' morale, reduce fatigue, absenteeism and accidents and improve quality and quantity of production.

Scientific Use of Color Helps Workers!

AFTER the Laconia plant of the Gilbert Clock Corporation was repainted according to Pittsburgh's new system of COLOR DYNAMICS, its resident manager, E. H. Newell, reported:

"We were so proud of its appearance that we invited 3,000 of our townspeople to an 'open house' so they, too, could enjoy it. So impressed were many of them that we were flooded with employment applications. Women liked its 'homeyness'. Our workers, especially those who produce very small parts, say the Seafoam Green walls are restful to their eyes."

COLOR DYNAMICS has scored similar success in many important plants. Factory executives are becoming increasingly aware that eye fatigue slows workers down more than physical fatigue.

Often it causes headaches, digestive upsets, "nerves," depression. These lead to poorer production and absenteeism.

Better shopmen everywhere are becoming familiar with this Pittsburgh system of using color to improve working conditions and plant efficiency.

We suggest that you include this new science in your shop courses. Write—today—for a free copy of our book, COLOR DYNAMICS. It contains a comprehensive explanation of these new principles and how they should be applied. Address Pittsburgh Plate Glass Company, Paint Division, Dept. IV-2, Pittsburgh 22, Pennsylvania.

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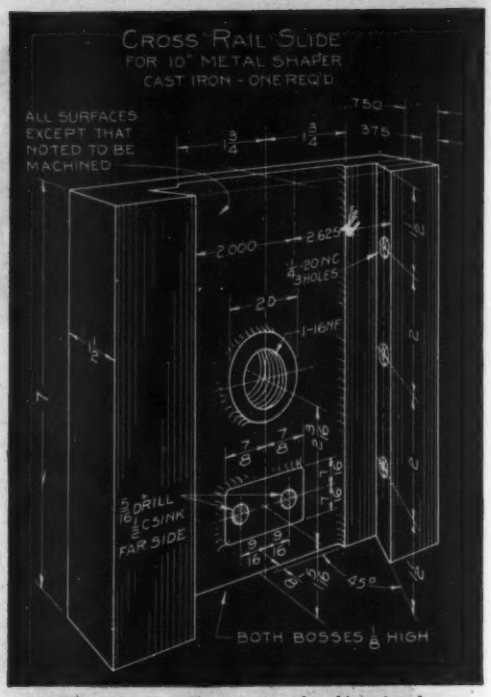

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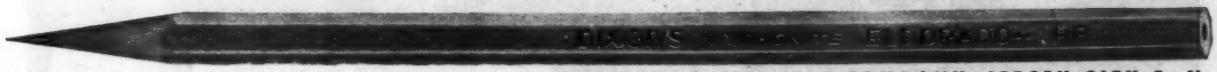

SCHOOL BUREAU, PENCIL SALES DEPT., JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY 3, N. J.

(Continued from page 22A)

education, Akron, Ohio; and Robert A. Campbell, assistant in industrial education, Trenton, N. J., were the speakers and their subjects were respectively "The General Shop Versus the Unit Shop," "Methods of Evaluating Junior High School Industrial Arts," and "Safety in Junior High School Shops."

Louis V. Newkirk, director of industrial arts, Chicago, Ill., led the discussion.

Kenneth Brown, assistant director of industrial arts, Philadelphia, Pa., was chairman at the Friday afternoon session, and Earl B. Milliette presided.

John R. Ludington, in his address on "Approaches to an Adequate Industrial Arts Curriculum in the Secondary School," emphasized that the best approach to a good industrial-arts curriculum is to make the student participate in a democratic way in the establishment of an industrial-arts curriculum. He also emphasized that woodwork, metalwork, and the like, are merely phases of industrial arts. They are not industrial arts in themselves.

S. L. Coover, head, department of industrial arts, State Teachers College, California, Pa., gave an interesting talk on "New Teaching Materials for Industrial Arts." He pointed out that aluminum is very easily formed and is cheaper than wood. It is readily cast and is quite easily obtained now at 5 cents a lb., in the form of scrap, or at 15 cents a lb. new.

Plastics also are available.

He also urged that in casting about for projects or problems for the drafting course, pupil interests should not be overlooked.

The Saturday morning session was under the chairmanship of G. Harold Silvius.

Colonel Verne C. Fryklund made the interesting observation that the two institutions now engaged in taking care of 1000 or more grounded or wounded airmen have discovered that these men are not at all interested in taking up work in airplane shops.

Merrill C. Hanburg, supervisor of aviation education, Detroit Public Schools, Detroit, Mich., in his talk on "Aviation Education in a Program of Industrial Arts," forecast some of the probable developments in aviation in the post-war era, and showed how necessary it was to train our children for the coming air age.

In his address on "Aviation Activities in Industrial Arts," Glenn A. Wagner, aviation supervisor, State Education Department, Albany, N. Y., warned against accepting a bomber to teach aeronautics in junior and senior high schools. He suggested that 75 per cent of the work should be devoted to laboratory exercises and 25 per cent to related subjects.

(To be continued)

♦ At the November meeting of the Bronx Guild of Associated Teachers of Shopwork, 25 supervisors and principals attended a round-table discussion meeting on programming and shop hazards.

The round table was composed of Mr. Abe Gendel, chairman; Mr. Max Schonberg, principal of Public School No. 117, the Bronx; Dr. Abraham Ehrenfeld, principal of Public School No. 120, Manhattan; and Miss Alice Donaher, principal of Public School No. 115, the Bronx. Mr. William Bell, Mr. Harold Lichtman, and Mr. Leon Goldfinger represented the shop teachers' group. Dr. Clare Baldwin, administrative director of junior high schools, New York City, acted as moderator.

The teachers and principals raised questions from the floor and these were discussed by the round-table groups.

Because of the great interest shown and the mutual benefit derived the guild plans to hold more meetings of a like nature in the near future. —*Henry Donis.*

♦ The Kansas City, Mo., State Teachers' meeting proved to be very informative and interesting. It was attended by approximately 100 teachers. J. R. Manly, of Southwest High School, Kansas City, was chairman and had organized a program dealing with industrial arts in the postwar period.

The program was as follows:

1. "Industrial Arts Builds General Education," J. G. Bryan, director of secondary education, Kansas City.

2. "Art and Industrial Arts Teaming Up," Geralding Mullinix, assistant art supervisor, Kansas City.

3. "Will Industrial Arts Grow Best With or Without Federal Support?," Don N. Valk, State Teachers College, Maryville.

4. "Curriculum Changes Which Our Teachers Colleges Will Make for the Years of Peace," R. E. Smith, State Teachers College, Warrensburg.

5. "Intensity of Vocational Education and Industrial Arts in Small Communities," Dr. H. H. London, associate professor of industrial education, University of Missouri, Columbia.

6. "How Has War Aided the Cause of Industrial Arts?," Roy Carter, Pratt and Whitney Aircraft Corporation of Missouri, Kansas City.

♦ Emphasizing that there is an increasing demand to give the student practical training in both college and high school and that teachers must more and more consult with industrial and business leaders on the nature of required training if the schools are to turn out the right kind of product, James F. Price, president of Kansas State Teachers College, Emporia, Kans., emphasized the need of cooperation between education and industry in his address on "The Business of Education" before the Northeastern Kansas Education-Industry Conference held in Topeka, Kans., last September.

The conference, under the joint sponsorship of the Kansas State Teachers Association, the Associated Industries of Kansas, the Kansas State Chamber of Commerce, and local Chambers of Commerce, working with the Committee on Cooperation With Education of the N.A.M., so stimulated the nearly two hundred educators and businessmen in attendance that plans were formulated for the organization of ten new local discussion groups in this state.

At the summation session, presided over by Fred Karr, manager of the Gas Service Company of Topeka, it was the feeling that all young people in the state ought to have at least a high school education; that a new tax policy should be evolved so that schools will be more adequately financed; that salaries, commensurate with training and ability, would raise the standards of teachers by "making it worth while for a teacher to stay a teacher."

(Continued on page 26A)

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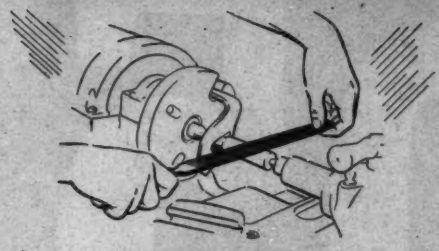
Filing Hints To Meet Your Needs



Lathe Filing

Widely used in industry for fitting and finishing shafts, lathe filing is an operation in which the file is stroked against the work while it revolves in a lathe. Lathe filing is commonly employed to correct the slight taper that sometimes results where the lathe cutting tool has been improperly ground or set for the wrong lathe speed or feed.

First,—select a Mill File. Or, if available, use a Long Angle Lathe File. Hold the file at a slight angle as shown in the illustration—with the work revolving towards the operator. Use a long forward steady stroke, moving laterally about half the width of the file on each stroke.

Beginners should be careful not to hold the file rigid or stationary, but to keep stroking continually.

NUCUT "Wavy Tooth" construction is a patented combination of coarse teeth and fine teeth that makes possible clean, deep, true cutting and also smooth finishing, both at the same stroke.

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America's Oldest File Manufacturers
Good Tools since 1836

Awarded to the Newcomerstown, Ohio, Plant

HELLER NUCUT FILES
WAVY TEETH

(Continued from page 24A)

♦ More than 200 educators and businessmen attended the Education-Industry Conference held at the University of Toledo, Toledo, Ohio, November 10. The session was sponsored by the Toledo Chamber of Commerce and the Toledo public schools. A discussion in which Charles LaRue, principal, Woodward High School, told businessmen what education expects of them, and Frank H. Adams, vice-president and general manager, Surface Combustion Company of General Properties Co., Inc., member Board of Directors, N.A.M., and first vice-president, Toledo Chamber of Commerce, in turn told what businessmen expect of educators, high lighted the program. The group was also addressed by E. L. Bowsher, superintendent of the Toledo public schools.

News Notes

♦ The business offices of "Education Abstracts" are now located at 1755 Broadway, New York 19, N. Y. For the past two years the offices were at 32 Washington Place, New York 3, N. Y., and prior to that time the offices were at Homewood, Ill.

♦ An A.V.A. committee, called into action by Commissioner of Education J. W. Studebaker, consisting of John A. McCarthy, president of the American Vocational Association; George H. Fern, Lansing, Mich.; George Parkes, Williamsport, Pa.; William F. Rasche, Milwaukee, Wis.; and Executive Secretary L. H. Dennis held a two-day conference on postwar education programs at Washington on August 10 and 11, 1944.

♦ Thousands of men and women, ranging in age from 17 to 65 years, are attending classes this year in an old school building on the lower east side, in New York City, where they are being trained for war service in the fields of radio and electrical communications.

The school is open from 8:00 in the morning to 11:30 at night, five days a week, on a year-round basis. Students attend in shifts, many reporting before or after their day's work in office or factory.

The courses include radio production work, radio service and repair, radio mechanics, radio operating, and FCC rules and regulations.

More than 20,000 persons have received short-term training in various branches of the communications industry since these courses were started in October, 1942.

♦ The National Bureau of Standards, of the U. S. Department of Commerce, has announced newly proposed standards, R35-44, for single, double, and multiple-tier steel lockers.

These standards are intended to eliminate two sizes of single-tier lockers, and to add two sizes of double-tier lockers, and three sizes of multiple-tier lockers. It changes the size of one multiple-tier locker, and provides for other changes and additions.

The standards sell for five cents and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

♦ The sales and accounting departments of Encyclopaedia Britannica Films, Inc., will be located at 20 North Wacker Drive, Chicago 6, Ill. The research and production departments under the direction of Dr. V. C. Arnspiger will continue to operate at its present location, 1851 Broadway, New York 23, N. Y.

♦ To help teachers and community leaders cope with outbreaks of infantile paralysis, the National Foundation for Infantile Paralysis, Inc., 120 Broadway, New York 5, N. Y., published and distributed free of charge, through health offices, settlement houses, insurance companies and its national office, more than 600,000 copies of a bulletin of helpful hints, "When Polio Strikes." This bulletin describes the symptoms of poliomyelitis and indicates the necessary precautions that should be taken, to avoid the spread of this dread disease.

♦ The National Foremen's Institute, Inc., Deep River, Conn., has made available the new edition of the "Presidential Recorder," containing a complete compilation of presidential election data. Minimum order, 5 copies for $1.

♦ A film series, called "Problems in Supervision," was produced by the Office of Education to help train thousands of new foremen and supervisors in war industries.

Following are the titles and running time:

150. A New Supervisor Takes a Look at His Job — 13 min.
151. Planning and Laying Out Work — 10 min.
152. Maintaining Good Working Conditions — 9 min.
153. Working With Other Supervisors — 8 min.
154. Introducing the New Worker to His Job — 16 min.
155. Instructing the Worker on the Job — 14 min.
156. Placing the Right Man on the Job — 13 min.
157. Supervising Workers on the Job — 10 min.
158. Supervising Women Workers — 11 min.
159. Maintaining Workers' Interest — 13 min.
161. Every Minute Counts (Lateness, Loafing, and Absenteeism) — 10 min.
163. Improving the Job — 9 min.
164. Maintaining Quality Standards — 10 min.
167. Using Visual Aids in Training — 14 min.
168. The Supervisor as a Leader, Part I — 14 min.
169. The Supervisor as a Leader, Part II — 13 min.

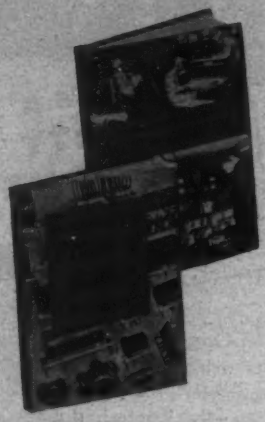
The pictures may be purchased from Castle Films, 30 Rockefeller Plaza, New York City, or they may be rented from many 16mm. educational film libraries. Copies of instructor's manuals are furnished without charge by the Office of Education to those who use these films in the training of war production workers.

♦ The Linde Air Products Company, 30 East 42nd St., New York, N. Y., has announced a complete and well-integrated slide-film training program on oxyacetylene welding and cutting, which is available to teachers in vocational schools. The films have been prepared in response to a need for supplying teachers and stu-

(Continued on page 28A)

NEW TEXTS AND MANUALS FOR TODAY'S COURSES . . . *in*

INDUSTRIAL ARTS



Radio

Shop Job Sheets in Radio

By R. N. Auble. Practical, what-to-do exercises in actual operational and production work, for use in shop or lab classes. Highly recommended as "the best of their type," by authorities in IRE *Proceedings* and *Electronics.* Bk. 1—Fundamentals; Bk. 2 — Service Problems . . . Each $1.50

Introduction to Practical Radio

By D. J. Tucker. An outstandingly thorough text on fundamentals for either class or home study. Includes all essential mathematics at the points needed. Gives hundreds of specific examples of the practical application of principles. Includes many problems, with answers. Illus. $3.00

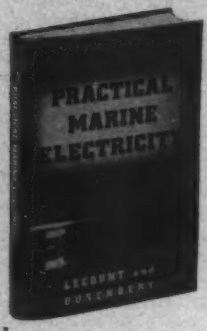
Principles of Radio for Operators

By Ralph Atherton. Provides complete, well organized materials for courses now being given to train ships' operators, technicians, maintenance men, etc. Covers electrical fundamentals and the operation of all parts of radio, including antennas. Over 500 illustrations. $3.75

Machine Shop

Lathe Operations
Milling Machine Operations

By Lewis E. King. Detailed directions, including all necessary technical information. Expertly organized for shop classes by a master toolmaker and supervisor of training for war-production workers in Detroit. Each Illus. $1.75



Electricity

Practical Marine Electricity

By LeCount and Dusenbery. A highly practical course on the principles and techniques of the installation, operation and maintenance of all electrical equipment found on merchant ships. Originally prepared by the Moore Dry Dock Co. to meet an acute need for skilled marine electricians. Thoroughly illus. $3.50

General Engineering

Engineering Preview

By L. E. Grinter and six other leading authorities on the various main branches of engineering and their foundation sciences. An excellent introduction for senior high school students and college freshmen to the chief theories, the basic tools and the important applications of modern engineering. Illus. $4.50

Photography

Principles of Photographic Reproduction

By C. W. Miller. Covers all basic principles and modern procedures — lens optics, monochrome and color reproduction, with unusually full material on the latter. Contains colored illustrations, much specific data on all aspects of photography. Illus. $4.50

Aeronautics

Aerodynamics

By L. R. Parkinson. A simple treatment of the principles basic to aircraft design. Includes all essential formulas, symbols, reference tables; much practical material on the atmosphere, wind tunnels, etc. Requires only high school mathematics. $2.25

For Teachers

The Craftsman Prepares to Teach

By D. F. Jackey and M. L. Barlow

An expert, simply written and highly usable guide to the methods of organizing and teaching all kinds of shop courses. Written to help the many who are now teaching such courses for the first time. Contains many specific examples of outlines for different types of courses, lesson plans, etc. $2.00

NOW IN PRESS

AIRCRAFT DRAFTING *by Hyman Katz* of Republic Aviation, Inc.
June $4.75 (probable)

AIRCRAFT WOODWORK *by Col. Rollen H. Drake,* recently of C.A.A.
June. $1.80 (probable)

MAKING PATENT DRAWINGS *by Harry Radzinsky,* Patent Attorney.
March $3.50 (probable)

THE BLUE PRINT LANGUAGE OF THE MACHINE INDUSTRIES *by H. C. Spencer,* Ill. Inst. of Technology and *H. E. Grant,* University of Wisconsin.
Summer. $2.00 (probable)

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(Continued from page 26A)

dents with adequate instructional materials, covering the basic welding and cutting techniques which must be learned.

The lessons, arranged in three series, consist of a slide film, instructor's supplements, and student's lesson booklets. The booklets contain a written record of the step-by-step procedure, and the instructor's supplement covers teaching techniques, quizzes, reading assignments, and wall charts.

The films and accompanying literature are available from the Linde Air Products Co. at a nominal price.

♦ The Vocational Machine Shop at Lafayette, Ind., has just completed a modern press gallery on its athletic field. The structure is 4 by 24 ft. and is divided into three parts, each part having ample space for five press or radio representatives.

The entire project was carried through by the student group. The operations consisted of drilling, milling, lathe and shaper work, flame cutting, and layout work. The plan of instruction gave students experience in subassembly in the machine shop and final assembly on the field.

The plans and specifications for the press box were suggested by the local *Journal-Courier* and Radio Station WASK.

Mr. H. J. Wills, machine-shop instructor, was in direct charge of the project, with Mr. Harry E. Taylor as director.

♦ Civilian nurses are urgently needed in the general and station hospitals of the Sixth Service Command in the states of Illinois and Wisconsin to care for returning sick and wounded soldiers. Civilian nurses will replace the commissioned nurses being sent overseas.

The salary is $2,190 per annum for a 48-hour week. There is opportunity for additional overtime and opportunity for advancement.

Secure an application at your nearest first- or second-class post office and mail it today to the 7th U. S. Civil Service Regional Office, New Post Office Building, Chicago 7, Ill.

♦ W. F. Currier, director of vocational education, Coffeyville, Kans., reports that 15 of the 19 students who were enrolled in the part-time pottery decorating course are now employed as decorators at a local pottery.

♦ A new industrial research and development organization, the Pyrene Development Corporation of Newark, N. J., has been formed as a subsidiary of the Pyrene Manufacturing Company, also of Newark, makers of fire extinguishing equipment and automobile tire chains.

The officers of the new organization, drawn from the executives and directors of the parent company, are Charles G. Durfee, president, Edward J. Waring, vice-president, and Edward A. Clapp, secretary and treasurer.

The new organization will not only carry out research on fire extinguishing equipment and compounds but will also work in the larger field of safety devices and other means for conserving life, health and property.

♦ Anticipating postwar personnel needs of industry and various community groups as well as of its own students, Syracuse university has adopted a plan for establishing a Psychological Services Center. Dr. Milton E. Hahn, nationally known coauthor of movie scripts on guidance, has been appointed as director of the center. Negotiations are under way to procure a release of a suitable building, now leased to the government, for use as center headquarters.

Service to veterans through individual case work will be one of the immediate functions of the center, which will also co-ordinate all university testing services, including the administration, scoring, and interpretation of psychological tests for entering students and secondary school or preparatory school students, for business and industry.

♦ Fourteen new motion pictures to aid in the training of war-production workers in vocational schools and war industries have been released by the United States Office of Education.

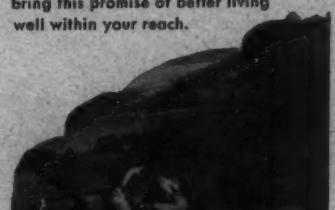
The new films cover such subjects as aircraft

(Continued on next page)

THERE'S A HEARTY WELCOME FOR YOU IN OREGON

In Oregon you can get more out of living and live better. In Oregon you'll find a cordial people, a friendly climate and ample career opportunities.

Homes with a view aren't unusual in Oregon because everywhere you turn there is a view. Four brief scenery-packed hours separate the blue Pacific from the towering Cascade Mountains . . . both are easily accessible when you live in Oregon. And, the opportunities available here, in the profession of education, bring this promise of better living well within your reach.



Oregon's modern progressive cities reflect the forward thinking of the State. Examples: Medford and Hood River, famous fruit centers; Corvallis, home of Oregon State College; Salem, the State Capitol; Astoria, historic port; and Portland, Oregon's metropolis, fourth largest Pacific Coast city famed for its homes and culture. Oregon is a wonderful place to live and make a living!

If you are interested in learning more about present teaching opportunities in Oregon, write Rex Putnam, Oregon State Superintendent of Public Instruction, Salem, Oregon, mentioning the grades for which you are qualified.

This advertisement is published in the interest of the great Oregon country by

The OREGON JOURNAL

PORTLAND, OREGON

Afternoon and Sunday

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(Continued from previous page)

maintenance, pipe fitting, welding, and engineering.

In addition to the motion pictures, film strips, which review and clarify important points in the films, and instructors' manuals, which describe the best ways of using the visual materials, are also available.

These training films may be purchased from Castle Films, Inc., 30 Rockefeller Plaza, New York City, and may be rented from many 16mm. educational film libraries. Film strips sell for $1 each. Instructors' manuals are furnished without charge to users of the films.

♦ The Eutectic Welding Alloys Company maintains a model welding shop and testing laboratory at its home office, 40 Worth Street in New York City. The welding shop has all the necessary equipment for electric arc, carbon arc, oxy-acetylene welding, gas flames, and furnaces. The shop, under the supervision of Mr. H. V. Kough, a welding specialist, is used by the Eutectic Company to test random samplings of its welding rods and fluxes in order to assure its customers complete satisfaction.

♦ "Three-Dimensional Seeing" is the name of an interesting booklet issued by the E. I. du Pont de Nemours & Co., Inc., Finishes Division, Wilmington 98, Del. It graphically describes how contrast spotlighting the working background and choosing the proper color treatment for walls and floors, increases production, reduces personal injuries, and improves morale.

New Publications

The Pipe Fitter's and Pipe Welder's Handbook

By Thomas W. Frankland. Imitation leather, 152 pages, 5¾ by 3¾ in., illustrated. Price, $1.25. The Bruce Publishing Co., Milwaukee 1, Wis.

An excellent reference book for students, beginners, and mechanics. It contains a helpful review of trade mathematics which presents many pertinent applications to problems which confront the mechanic who does pipe fitting.

The book also gives explicit directions for making pipe-welding layouts, and it contains a number of very valuable reference tables.

Alternating-Current Circuits

By Earle M. Morecock. Cloth, 275 pages, 6¼ by 9½ in. Published by Harper Brothers, New York, N. Y.

A textbook designed for students in technical institutes, full-time vocational schools, and junior colleges. It presents the subject matter in four chapters which contain descriptive and illustrative material on a.c. waves and quantities, vectors and complex quantities, and single-phase and poly-phase systems.

Elements of Machines

By Frank L. Verwiebe, Elmer E. Burns, and Herbert C. Hazel. Cloth, 222 pages, 6¼ by 9¼ in., illustrated. Price, $1.24. D. Van Nostrand Co., New York, N. Y.

A textbook based on the outline published by the U. S. Government for preinduction courses. It is divided into 14 units which present the subjects under the following headings: matter; measurements; theory of machines; simple machines; the hydraulic principles; molecules; forces; heat energy; solids; liquids and gases; changes of state; heat engines; heat transfer; energy derived from fuels; and the automobile.

The book also contains a list of experiments, some of which are to be performed by the student, while others may be used by the teacher for demonstration purposes.

Sheet Metal Theory and Practice

By John C. Butler. Cloth, 173 pages, 8¾ by 11¼ in., illustrated. Price, $3. John Wiley and Sons, Inc., New York City, and Chapman and Hall, Ltd., London.

A text specially prepared for training workers for the sheet-metal work required to further war production in one of the large West Coast Navy Yards.

It initiates the learner to a knowledge of the tools and machines used; welding, riveting, and soldering; the making of seams and locks; ship terms commonly used; blueprint reading; measuring and using templates and patterns; seam allowances; materials; and shop practice.

Vocational-Technical Training for Industrial Occupations

Vocational Division Bulletin No. 228. Paper, 307 pages, 5¾ by 9⅛ in. Price, 40 cents. Superintendent of Documents, U. S. Office of Education, Washington, D. C.

This is a report of the consulting committee on vocational-technical training appointed by the U. S. Commissioner of Education.

A study of 99 industrial concerns in New Jersey revealed a ratio of 4.4 technicians to each engineer. Studies made in different industries show that this ratio varies from 2 to 20 technicians per engineer. This report then shows the need for vocational-technical training and how suitable training programs may be organized and instituted.

Automotive Electrical Equipment

By William H. Crouse. Cloth, 232 pages, 6¼ by 9¼ in., illustrated. Price, $2. The McGraw-Hill Book Co., New York City.

A book which may be used as a text for the learner or as a reference book by the serviceman on the job. It contains both theory and practice and is well illustrated, and descriptions are in plain understandable terms.

Arc Welding Engineering and Production Control

By Walter J. Brooking. Cloth, 347 pages, 5¾ by 8½ in. Price, $4. The McGraw-Hill Book Co., New York, N. Y.

This book is designed to give the beginning operator, production foreman, student welding engineer, and the welding inspector a good background for their respective duties.

Besides showing how welding operations are to be performed, such questions as welding and mass production; welding control and specifications; jigs and fixtures; cost of poor fit up; mass training operators; production equipment; d.c.

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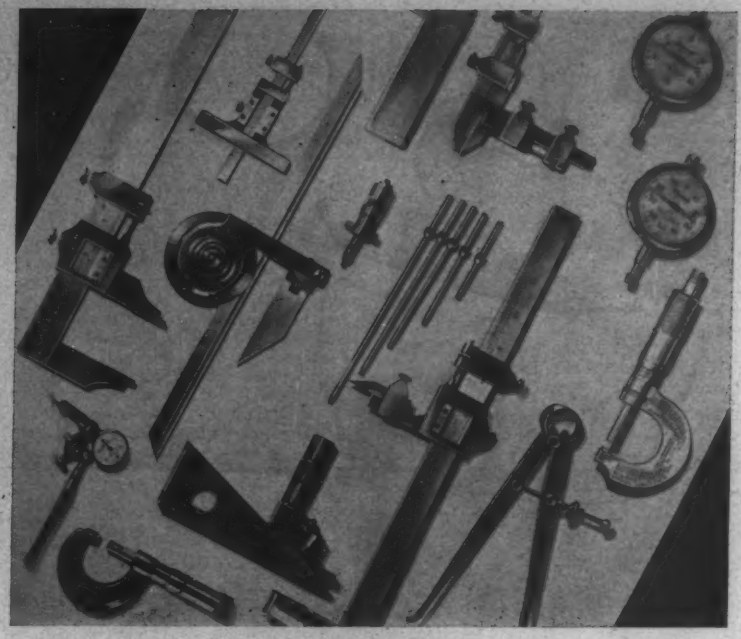

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"The Starrett Book for Student Machinists" is chock full of practical information and reference data. Only 75 cents a copy at your regular Starrett Tool distributors! Write for descriptive folder "CE."

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NEW PUBLICATIONS

(Continued from previous page)

and a.c. welding operations; electrode selection; production; machining, cleaning, and painting; and arc welding for field service; are quite fully discussed.

Vocational Training for War Production Workers

By Charles W. Sylvester. Paper cover, 56 pages, 8½ by 10¾ in. Published by the Department of Education, Division of Vocational Education, Baltimore, Md.

An annual report of the vocational training offered to war production workers by the city of Baltimore.

Half a Million Forgotten People

Textile Workers Union of America, CIO, 15 Union Square, New York 3, N. Y.

What Your Town Needs for the Coming Air Age

Piper Aircraft Corporation, Lock Haven, Pa.

Shop Equipment News

New Products—Publications

DELTA—MILWAUKEE DUST COLLECTOR

The Delta Manufacturing Co., Milwaukee 3, Wis., has developed a new dust collector unit which can be used with industrial machines used for grinding, polishing, buffing, sanding, or similar operations. It is provided with special fittings permitting its attachment to any one of several Delta-Milwaukee machine tools.

The dust collector is activated by a powerful fan that sucks both fine and heavy dust and small particles through an efficient air filter. The larger particles fall into a removable pan at the bottom. The filter is a permanent, cleanable one with low air resistance and is completely fireproof. A special woven glass filter also is available for use in collecting "flour fine" dust.

Delta—Milwaukee dust collector

The cabinet of the unit is of pressed steel finished in the shade of gray employed in all Delta-Milwaukee machine tools. The activating fan is a high-efficiency unit of the squirrel-cage type and moves 350 cubic feet of air per minute, developing a static suction of 3 to 4 inches.

Power is furnished by a ⅓ h.p. motor of 3450 r.p.m. This motor has sealed-for-life ball bearings, eliminating lubrication problems, and is located in a separate sealed compartment insulating it against harmful dust.

For brief reference use IAVE—210.

SALVAGE AND EXTENSION WELDING OF SMALL TOOLS

A new DoAll Butt Welder has been developed by Continental Machines, Inc., which extends the application of the band saw butt welder to that of making extensions to small tools, salvaging broken tools, and for small miscellaneous welding operations.

Salvaging and extension welding

This new DoAll welder is completely automatic and is easily operated by unskilled help with a minimum of instruction. Operation consists of four simple steps which assure precision welding: (1) insertion and clamping of article into the welder jaws; (2) pressing the welding switch; (3) pressing the annealing switch; (4) dressing off the weld flash.

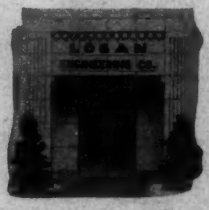
(Continued on page 32A)

Logan

...a name to remember when you think of BETTER lathes

A lathe is judged by the kind of job it does, and by nothing else. That one fact explains why Logan Lathes have made such headway. The men in the shops, and the executives as well, *like* the kind of job that Logan Lathes do. Here are four reasons why:

- Advanced engineering in the spindle mounting, in the countershaft, in the back gear arrangement, in the bed construction, and in many other points.
- More exacting standards and closer tolerances are maintained in building Logan Lathes.
- Logan Lathes are built in a new, modern factory, equipped with the best machinery and tooling obtainable.
- A management policy, stressing quality of production rather than volume that has produced a personnel of loyal workers.



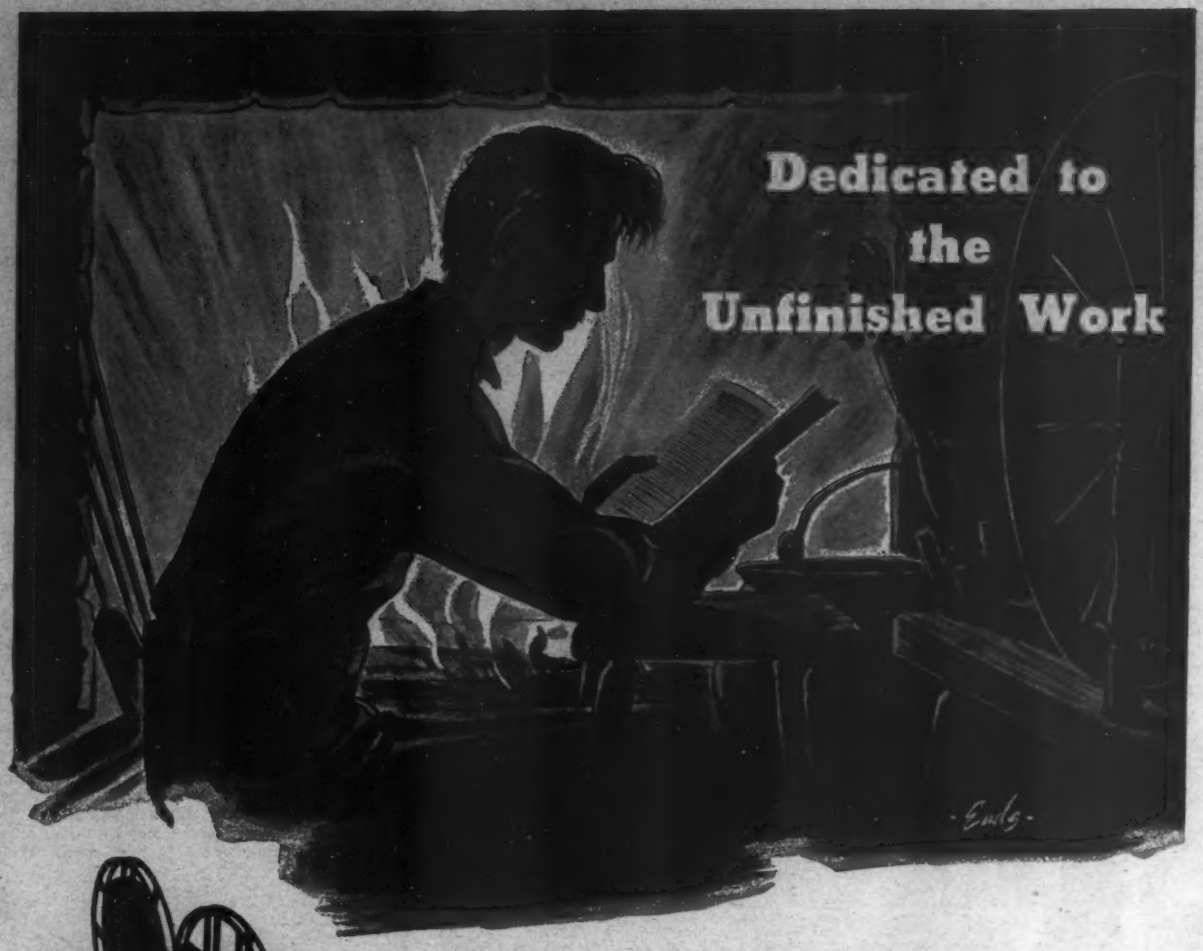
Further messages in this series will give you more reasons why it will pay to see your Logan dealer or get the Logan catalog before you buy a lathe.

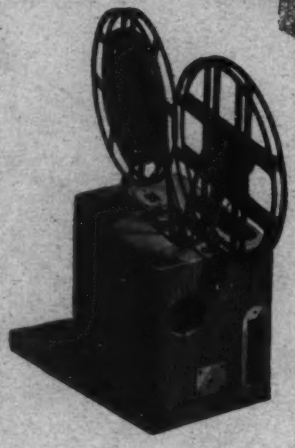
LOGAN ENGINEERING CO.

CHICAGO 30, ILLINOIS

A6

Logan — a name to remember when you think of BETTER lathes





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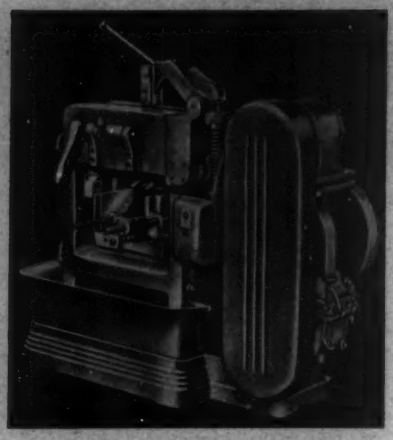

Mechanically-driven metal cutting saw

bearings above and below the saw blade. Hardened and ground renewable inserts take all strain and wear as the saw frame reciprocates, giving sustained cutting accuracy at low cost for years of service.

A full description of this saw specifications are given in a new bulletin, No. MC-51. A copy may be had by writing Peerless Machine Co., 1600 Junction Ave., Racine, Wis.

For brief reference use IAVE—213.

NEW 6-IN. SQUARE TURRET TOOL POST

Dept. 54, Enco Manufacturing Co., Chicago, Ill., announces the new 6-in. square turret tool post for use on lathes with 16-in. swing and larger lathes. The center post, almost 5 in. in diameter, gives extreme rigidity under heavy cuts for the larger tools at high speed. The turret

block is designed to mount up to 1¼-in. tool bits or No. 2 tool holders for ⅝-in. square bits where additional flexibility in operation is required. The indexing mechanism is self-contained and eliminates all chip interference, thus assuring maintenance of an accurate setting in production. Mac-it tool post screws are standard on this model. Model 6-S also is available with lower portion of base left machinable for quick adaption to any given lathe.

For brief reference use IAVE—214.

NEW LATHE CATALOG

The new South Bend Lathe Catalog No. 100-D, distributed by the South Bend Lathe Works, South Bend 22, Ind., contains 21 full-color lathe illustrations, together with descriptions of all engine lathes, toolroom and precision turret lathes manufactured by this firm.

The engine lathes and toolroom lathes are shown in five sizes, ranging from 9 to 16 in. swing. There are two sizes of the turret lathes, each with ½ and 1 in. collet capacity.

Constructive features of the lathes, lathe tools, and the various attachments also are illustrated and described.

(Continued from page 30A)

The butt welder is available either as a table model or as a pedestal type. Both have the same capacities.

Complete specifications and illustrated literature are available from Continental Machines, Inc., 1301 Washington Ave. So., Minneapolis 4, Minn.

For brief reference use IAVE—211.

PRECISION WET BELT SURFACER

A new wet belt surfacer with automatic feed table has recently been announced by the Porter-Cable Machine Co., Syracuse, N. Y.

The automatic feed table is supported rigidly so that close tolerances are easily held. The coolant and grindings or chips fall immediately into a large drawer, from which the chips are easily removed. Coolant capacity is 35 gallons.

The automatic feed table makes the new model BG-8 a high speed production machine tool, capable of cutting operating time considerably, while the hydraulic control and mechanical settings absolutely control the speed, pressure, finish, and size.

For brief reference use IAVE—212.

MECHANICALLY-DRIVEN METAL CUTTING SAW

To meet the need for a metal cutting saw, having full mechanical drive, four-sided saw-frame performance, and finger-tip control of the feed pressure, Peerless Machine Company presents the new Mechani-Cut model. This saw cuts at higher speeds with absolute precision and is convertible to manually operated conveyor operation right on the job. It is available in capacities of 7 by 7 in., 11 by 11 in., and 14 by 14 in.

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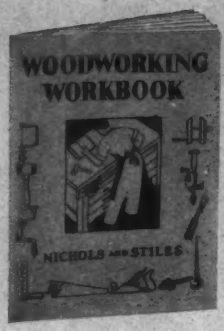

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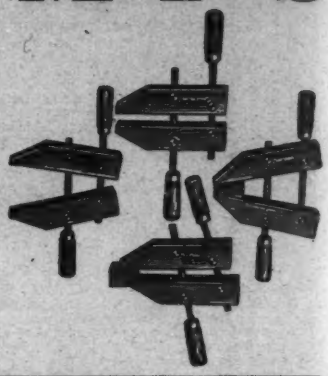

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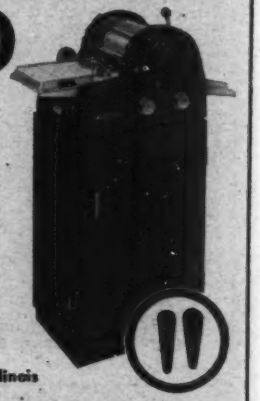

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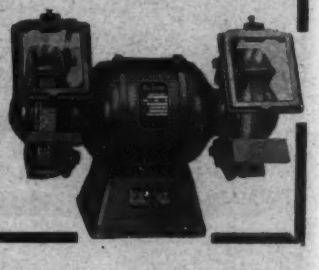

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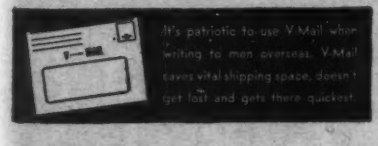
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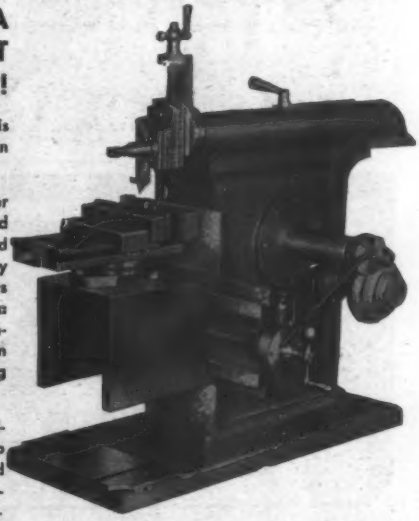

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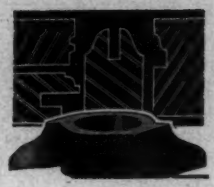

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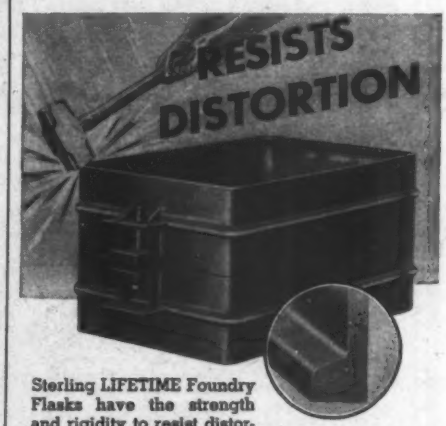

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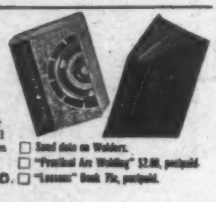

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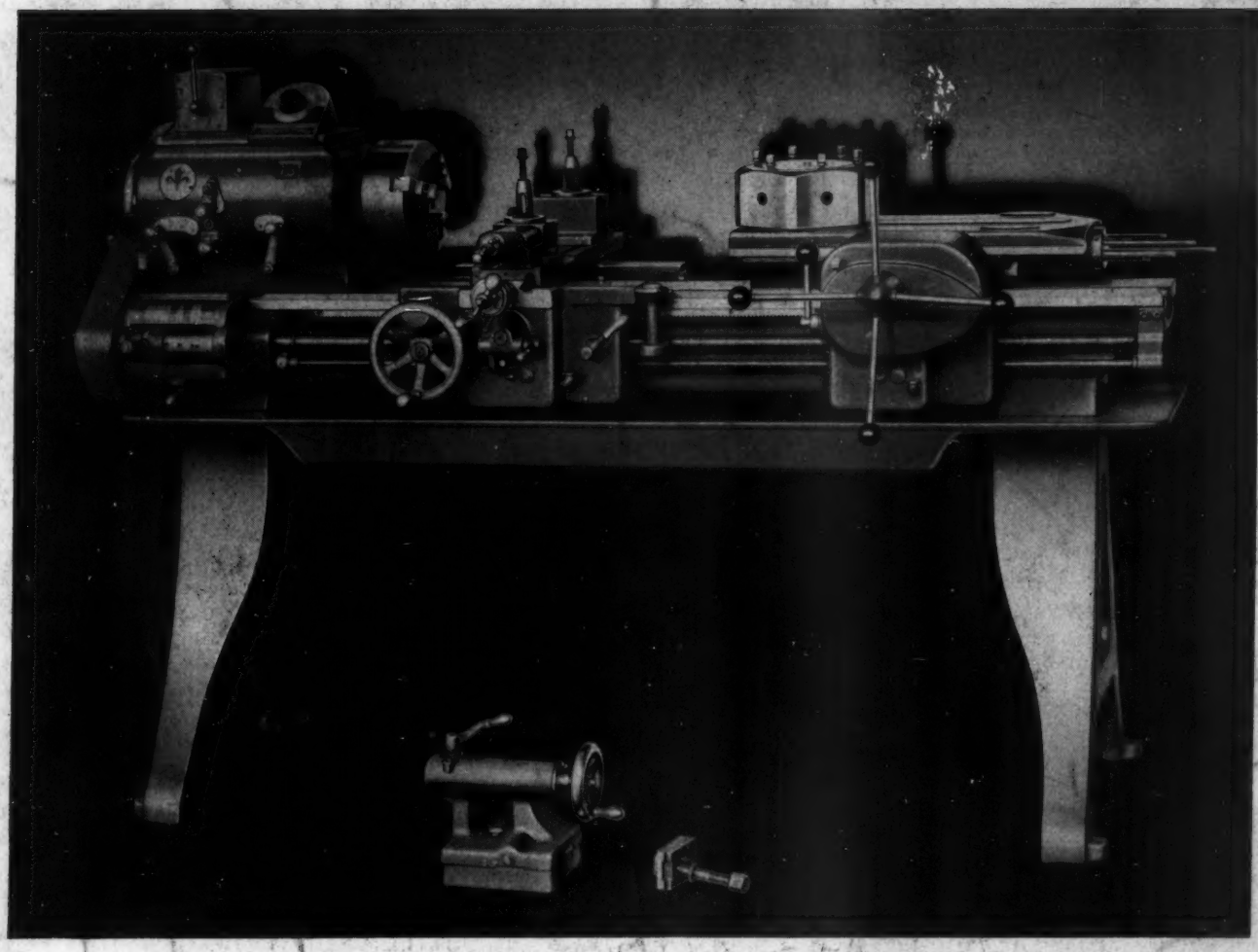

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